

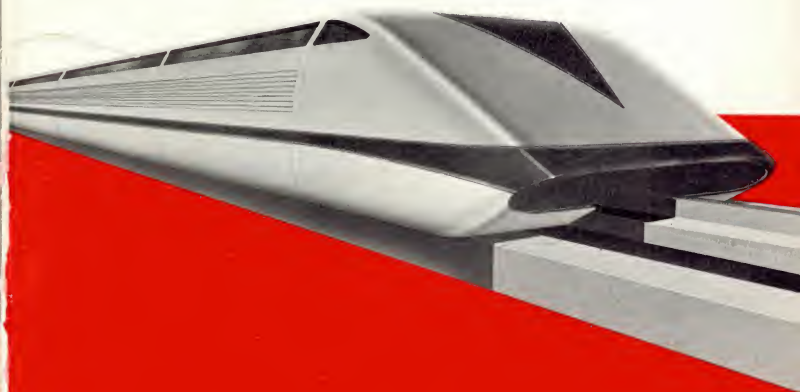
new scientist

15 February 1973

Vol 57 No 833

Weekly 15p

Australia 35 cents/
Canada 60 cents/
New Zealand 35 cents/
South Africa 35 cents/
USA (by air) 90 cents/
BF 25/FF 3/DM 2.80/
hfl 1.75/skr 3.00/



Magnets boost the super train

Conversation Pieces

Technically intriguing items
from TRW, guaranteed to add luster to your
conversation and amaze your friends.

Ob Say Can You See Discussions about whether or not we should "go into space" often overlook a fundamental point—namely, that we are in space already. Each of us is an astronaut on a spacecraft called earth traveling around the sun at 18,000 miles per hour. The biological community that lives on the spacecraft has a fragile life support system—the thin film of soil, air and water in which we dwell. During the past century, the number of passengers aboard the spacecraft has increased tremendously; so also has their ability to consume its finite supplies. We see some of the results in the pollution of our environment and the decay of our resources.

As astronauts we need to take care of our spacecraft—to check on its status, to monitor its resources, and to see that we are not doing irreparable damage to its vital life support system. With this in mind, NASA has undertaken several programs which will bring the technology of space to bear on some very down-to-earth problems. One of these programs involves the development of advanced sensors. From the vantage point of a satellite orbiting the earth, these sensors will someday be able to monitor air quality, determine the condition of crops, or help locate mineral resources.

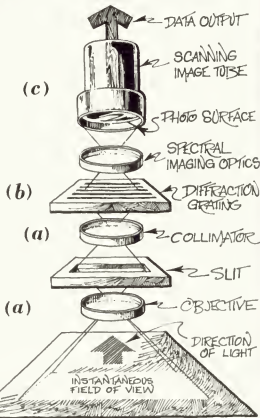
Currently, TRW is developing such a sensor for NASA. It is called MOCS, an acronym for Multichannel Ocean Color Sensor. MOCS is based on the principal that each object on earth reflects light in a unique manner. The light reflected from oil, for example, is quite different from that reflected from water. Thus the two objects can be distinguished on the basis of their spectral response or "signature." MOCS senses the radiation reflected from objects in its field of view and diffracts this radiation (see illustration) into its spectral components. It has better spectral resolution than any other available scanner.

MOCS weighs less than 20 lbs., has no moving parts, and uses only 7½ watts of power. Yet it has produced some fascinating information about the spacecraft on which we live. Recently, for example, we tested MOCS by flying it in an aircraft at 37,000 feet over Clear Lake in California. MOCS showed that the lake teemed with sediments, algae growth, and foreign matter. In fact, the only thing clear about the lake was its ironic name.

We're happy to be associated with the excellent work NASA is doing in remote sensing. We hope that MOCS and other NASA sensors will help make spacecraft earth a habitable home for us all.

The Multichannel Ocean Color Sensor

Lenses (a) focus light through a slit onto a diffraction grating (b) which separates the light into its spectral components. These are focused on a disector tube (c) which shows spatial variations of light across the field of view in one direction and spectral variations in the other. The raster scan then gives an electronic signal proportional to the spectral radiance of each spectral band in each element across the field of view.



For further information, write on your company letterhead to:

TRW
SYSTEMS GROUP

Attention: Marketing Communications, E2/9043
One Space Park Redondo Beach, California 90278

Editor: Dr Bernard Dixon
Deputy Editor (Science): Dr Peter Stubbs
Deputy Editor (Technology): Nicholas Valéry
Managing Editor: Richard Fifield

Science Policy Editor: Dr Martin Sherwood
Life Science Editor: Dr Roger Lewin
Social Editor: Ian Low
Technology Editor: Michael Kenward
Technology Policy Editor: Dr Joseph Hanlon
Technology News Editor: David Clutterbuck

Assistant Editor (Production): Compton F. Infill
Art Editor: Margaret Webb
Assistant Art Editor: Alan Middleton
Artists: Neil Hyslop, Michael Peyton

Washington Bureau: Graham Chedd

Consultants
Astronomy: Dr Simon Milton
Biochemistry: Dr Robert Freedman
Biology: Colin Tudge
Computers: Hadley Voysey
Education: John Dells
Environment: Jon Tinker
Marine: Tony Loftis
Soviet Science: Dr Sarah White
Telecommunications: Ron Brown

Advisory Panel
Dr Monty Finniston FRS
Sir William Glasfirth FRS
Dr Baell Mason FRS
Professor Sir Michael Swann FRS

Monitor	350
Technology review	363
Feedback	382
Westminster scene	384
Washington view	384
Venture	385
Scientific gardening	386
Out and about	388
The week ahead	387
Tantalizer	387
Letters	393
Grimbledon Down	393
Ariadne	408

Comment Dr Joseph Hanlon, Stanley Johnson, Graham Chedd, Dr Bernard Dixon	347
--	-----

Breeding bulls for higher steaks Dr David Allen	356
--	-----

Dropping the tracked hovercraft Richard Hope	358
---	-----

Magnets boost high speed trains Dr Joseph Hanlon	360
---	-----

Black Panthers in and on science Dr Curtis Powell and Clark Squire talk to Ann Rosenberg	369
---	-----

Vitamin D changes its clothes Dr Roger Lewin	371
---	-----

No halt in the nuclear arms race Stephen Rowe	373
--	-----

British professions and EEC rules Lord Bowden	375
--	-----

The Copernican revolution J. G. Crowther	378
---	-----

Review Professor Ian Roxburgh, Dr John Rowan Wilson, Dr Peter Stubbs, Dr Andre Balogh, Desmond Hawkins, Dr Simon Milton, Dr Bryan Winchester, Professor Robert Weale, David Dickson, Dr Martin Sherwood, Colin Moorcraft	388
---	-----

Prices quoted in this issue were correct at time of going to press. From 1 April 1973 there will be no purchase tax but a large number of goods will carry Value Added Tax

PUBLISHED WEEKLY

Annual subscription: £8.50
USA and Canada (airfreight) \$29.25
Back numbers (cash with order) 35p
Including postage from IPC Magazines Ltd,
65-69 Great Queen Street, London WC2E 8DD
Registered at The Post Office as a newspaper
and printed in England
2nd class postage paid at Jamaica NY, 11431
© IPC Magazines Ltd, 1973

OVERSEAS ADVERTISEMENTS REPRESENTATIVES

USA: Johnson, Jordan, Harrison & Schulz Inc., 57 Post Street, Suite 712-715, San Francisco, California 94104
(415) 382-8794, and 1901 West Eighth Street, Los Angeles, California 90057 (213) 483-8530
East Coast and Mid West,
HGI International Corporation, 230 Park Avenue, New York, NY 10017 (212) 688-5961
CANADA: Clement Dick, OBE, Chimney Copse, RR No. 1, Churchill, Ontario, Canada. (705) 486 2341.
JAPAN: International Media Representatives Ltd, 1, Shiba-Kotohiraicho, Minatoku,
Tokyo, Japan. Tel: 932-0856, Telex: 22533
AUSTRIA, GERMANY, FRANCE, SWITZERLAND, SCANDINAVIA, RUSSIA: HGI International Ltd,
28 Great Queen Street, London WC2E. Tel: 01-242 5173/4/5. Telex: 282009. Cables: Tribnews London
BENELUX: Advertisement Department, New Science Publications, 128 Long Acre, London WC2E 9QH.
Tel: 01-836 2468. Telex: 27253. Cables: Newscient London WC2

This One



H1CX-FJY-9NKN



*We've changed our outline—
but not our outlook!*

It's a new symbol—but it still spells satisfaction. The symbol of Thos. W. Ward Limited—parent company of The Ward Group, providers of just about every industrial requirement. Through Ward's 13 divisions and 63 companies, you have available at your fingertips, plant, materials and services covering the essential needs of engineering, construction, iron and steel, transport, chemicals, and other major industries. The new symbol sums up The Ward Group's philosophy—up-to-date, vigorous and standard-setting!

THE WARD GROUP



Head Office: Thos. W. Ward Limited, Albion Works, Sheffield S4 7UL
London Office: Chestergate House, Vauxhall Bridge Road, SW1V 1HE.

Comment

The technological power broker

Sitting next to a goldfish pond in the centre of his spacious study in his large house in the Surrey stockbroker belt, cyberneticist Stafford Beer spoke glowingly of the Marxist revolution in Chile and explained that "cybernetics is mappable onto Marxist-Leninist theory". He has also said that "liberty must be a computable function".

Beer now has a chance to test his theories in a big way—a computer system to monitor the entire economy of Chile (see Technology Review, p 363). If this is successful, Beer will have created one of the most powerful weapons in history. Already, one-quarter of the country's industry reports daily to the computer, which compares the reports to "capability" and looks for deviations from normal. If the computer sees something it doesn't like, it sends a message to the factory manager. If he doesn't take action, the computer automatically tells his boss.

Highly significant events, such as strikes and breakdowns at critical points, are reported immediately to higher government levels. A central "operations room", which looks as though it belongs in the film 2001, is used by government officials to analyse data and do computer simulations for future strategy. The system could give unprecedented power to the Allende government, and reportedly was an important element in breaking the "bosses strike" last October.

Beer is overtly political—he jets frequently to Chile because he believes in Allende. He offered a similar system to the newly elected Wilson government in Britain, but was refused—just as well because he says that he would not have done the job for the man Wilson turned out to be. Now, he would not create such a system in Britain unless "there was a revolution first. But that couldn't happen, because the British people are sheep".

He is very conscious that his system of "real-time control" of the economy represents power, but "I know that I am making the maximum effort towards the devolution of power. The government made their revolution about it; I find it good cybernetics". When pressed, Beer argues that devolution of power comes from two factors. First, a manager obtains information sooner than he normally would and can act on it without his superior even finding out that there is a problem. But he must act on what the computer system thinks is a problem, because if he does not, his superiors will be told. And Beer admits that it would be a simple reprogramming job to take out this safeguard. It also seems likely that managers will soon act to make the computer respond correctly, independent of the actual factory. Second, Beer is only now working on a feedback for the peasants. Apparently this would be a two-way link providing a way for viewers to respond to TV programmes, and a central computer summing up their views.

Thus we have Beer's view of Chile: a computer system



monitoring all of the economy, designed by a small group of scientists and imposed from the top in secret. Managers have autonomy so long as they do what the computer expects. The peasants and workers will be permitted to respond to TV programmes.

Beer talks a lot about freedom. His first public description of the system, given yesterday (14 February), was titled "Fanfare for Effective Freedom". He argues that we must steer between an autocratic system and a "permissive system" which robs people of "guidance and help". He believes that "there ought to be a computable function setting the degree of centralisation consistent with effectiveness and with freedom". It is clear that he believes people must be managed from the top down—that real community control is too permissive.

Beer sees the major distortion in government as the delay which information takes to reach the top, and proposes a technological solution. But he has missed the real distortion—when you make decisions for someone else, your own problems and values intrude. Beer's system gives the most power to Fernando Flores, Minister of Finance, who has risen through four government posts in two years. Surely concerns about his career must intrude on concerns for the unseen people when he uses the system.

But this distortion cannot be ended technologically—only politically, by a sharp change in power relationships. Beer cannot do this, so he has set out to solve the political problems technically by "creating a scientific way of governing" that is "neutral with respect to belief structure and value judgements".

The result is a tool which vastly increases the power at the top. "All technology can be, and usually is, abused," he conceded. But we must "take technology away from the people who abuse it, like IBM". And give it to those who will not, like Allende?

Few people have ever had as much power to give as Stafford Beer. He has chosen to give it not to the people, but to a government he approves of. With a shrug of the shoulders, he says he has only "provided tools" and is not a technocrat because he does not actually govern. "I am a scientist; but to be a technocrat would put me out of business as a man."

Many people, however, will think Beer the super-technocrat of them all.

Joseph Hanlon

World Population Year 1974

Rafael Salas, who gave a talk at the Royal Institute of International Affairs last Wednesday, is executive director of the United Nations Fund for Population Activities (UNFPA). He joined the fund in 1969 when it had only been in existence for two years and when the total resources available for use hardly exceeded \$1 000 000. Today, the fund has seen perhaps the most spectacular

growth of any international organisation. Its budget has increased to over \$40 000 000 a year; it has supported major population projects in such countries as Pakistan, Iran, India, Indonesia, the Philippines and Thailand. UNFPA's approach to the global problem of population growth can be divided into three broad areas. In the first place it promotes government awareness of the social

and economic implications of population problems. Second, it provides systematic and sustained assistance to developing countries who seek to define and solve these problems. Third, it helps organisations within the United Nations system to become more effective and efficient in planning, programming and implementing population projects supported by UNFPA.

UNFPA has also been instructed by the United Nations General Assembly to prepare for World Population Year 1974. The highlight of WPY will be the World Population Conference, to be held in August 1974 at a so far undecided venue. For the first time this will be an official governmental, as opposed to scientific, conference. Though

it is misleading to attempt to draw too close a parallel with the June 1972 Stockholm Conference on the human environment, there is no doubt that the political problems facing men like Salas and Don Antonio Carrillo Flores (a former foreign minister of Mexico who is secretary general of the conference) are not less complex than those which faced Maurice Strong in Stockholm. Yet if the governments of the world do not use the World Population Conference of 1974 to achieve some kind of global consensus on the need to slow down rampant population growth, the prospects for mankind will be dim indeed.

Stanley Johnson

Initiatives on threatened species

This week delegations from over 60 nations assembled in Washington in the hope of thrashing out a convention to regulate international trade in animals and plants threatened with extinction. Such trade, mainly in furs, animal products, pets and animals for research, has long been recognised as having a "dramatic impact" on the "rapidly accelerating" rate of animal and plant extinctions, according to Russell Train, chairman of President Nixon's Council on Environmental Quality and head of the US delegation to the conference. Train is optimistic that a draft convention prepared by two of the countries most involved in the wildlife trade, the US and Kenya will be adopted.

The size of the international market in wildlife is staggering. In 1971, for instance, the US imported 89 000 mammals, 770 000 birds, 2 million reptiles, 573 000 amphibians and 98 million fish. It is obvious that the world cannot maintain this rate of exploitation without a serious worldwide decline in wildlife, and the danger of new extinctions. Several of the imported species are already on the brink: the 1970 US imports of golden marmosets, for instance, represented about one-half of the estimated world population of the species. The fur trade, too, is taking its toll. In 1969, the US imported the whole hides of nearly 8000 leopards, 133 000 ocelots, and 1885 cheetahs. The endangered species conservation act passed by Congress in that year put an end to the (recorded) importation of cheetah hides, but the drop in the number of imported leopard and ocelot hides that has taken place since is ascribed more to a shortage of supply than legal controls.

The US-Kenya draft provides for a system of export permits. The authorising agency of each exporting nation will grant permits only if it is satisfied that the export is not detrimental to the species' survival, that the killing or capture was lawful, and that humane shipment will be provided for live animals. Importing countries will

accept wildlife consignments only if they are accompanied by an export certificate. The new UN Environment Programme in Nairobi (UNEP) will monitor the permits, and keep a weather eye open for any dangerous trends. It will be able to act only in an advisory capacity, however, individual countries signing the convention setting their own quota levels. Exporting nations which may in the short term reap the benefits of other's restraint will soon find themselves with no animals left to sell. Meanwhile, the requirement that every wildlife shipment be accompanied by an export permit should make life hard for poachers. Whales and other endangered ocean animals, such as the hawksbill turtle and the monk seal, will come under the convention, and here it will be up to the importing nations to exercise restraint. No one expects the International Whaling Commission's quota system to be affected by the convention. And although primates for medical and scientific research are on the agenda, the draft convention specifically refers only to orang-utans and chimpanzees.

Train's optimism that the conference will result in a binding convention signed by the great majority of the 60 nations attending rests mainly on the high turnout of participants, itself a result Train believes of the environmental awareness created around the world as a result of last year's Stockholm conference. He also has good reason to be sure of the Soviet Union's support. A party of US wildlife experts returned recently from Moscow where it concluded an agreement to set up more than 20 cooperative projects with the USSR on the conservation of rare and endangered species and general wildlife conservation and management. The US delegation, a member of whom popped into London on the way back from Moscow to sound out Britain's attitudes to the draft Washington convention, was favourably impressed by the Soviet Union's rapidly increasing concern with environmental matters.

Graham Chedd

The folly of neglecting philosophy

The BBC is to be congratulated for allocating two hours of Radio 4 on Tuesday evening this week to the question of science and God. Not only in California, where creationists and geneticists have been squabbling recently over schoolbooks (see *New Scientist*, 8 February, p 317), but also in many other arenas and publications these days, the conflict between science and religion is far from dead. As Tuesday's programme illustrated once again, when extreme protagonists on either side do treat the issue as archaic or irrelevant, this is usually a result not of great wisdom (or of intellectual arrogance) but of a simple neglect of philosophy. Many intelligent religious believers

still haven't a glimmer of insight into the strength of scientific method or the biological and physical case against a religious interpretation of reality. Many agnostic scientists, on the other hand, are perilously ignorant of the philosophical weakness of their scientific world-view—the subjective underpinning of the allegedly secure, objective knowledge of science, for example. This is an ideological divide far more serious than any other that supposedly separates artist from scientist. And there are few signs, at any level of education, that we are doing much about it.

Bernard Dizon

Henri Stefan Oppen de Blowitz

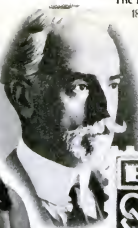
The Times Chief Paris Correspondent 1875-1902

The most quoted and feared correspondent of his day. He scooped the world by publishing the whole text of the Treaty of Berlin at the moment it was being signed in Germany.

**Henry Wickham Steed**

The Times Correspondent in Berlin, Rome and Vienna:

1896-1914. He made his mark by his revelation of a secret treaty between Germany and Russia dating back to 1890 and made behind the backs of Germany's partners in the Triple Alliance.

**James David Bouchier**

The Times Correspondent in the Balkans 1888-1918

Regarded as a Bulgarian national hero and a father of Bulgarian independence, he is the only journalist to be commemorated by an issue of foreign stamps.

**Sir William Howard Russell**

The Times War Correspondent:

1844-1871. The first and greatest war correspondent. He covered the Franco-Prussian War, the Crimea, the Indian Mutiny and the American Civil War. He also coined the often misquoted phrase 'the thin red streak'.

Like father, like son.

The standard set by The Times European Correspondents of the past is the standard we set ourselves today.

In 1973, we report on perhaps the most significant event of all, Britain and the enlarged EEC. To cover all the developments as they arise,

The Times has a unique link with Le Monde, La Stampa and Die Welt and more Times Correspondents in Europe than ever.

While history has yet to make some of today's Times European Correspondents famous, their standards already are.



**The more you think about Europe,
the more you need The Times.**

Monitor

Soviets claim to have made metallic hydrogen

It has long been suspected that at low temperatures and sufficiently high pressures hydrogen would pass into a metallic state. In 1935 Eugene Wigner published a theory to that effect. According to a brief report in the West German newspaper *Die Zeit*, Soviet researchers at the Institute of High-Pressure Physics have now attained that objective. A short paper by F. V. Grigorev in the Russian journal of Experimental and Theoretical Physics gives the relevant details.

The report describes an explosive technique in which the researchers achieved a pressure of 2-8 Mbar. The hydrogen was cooled to 20 K. Under these conditions the Soviet workers, apparently using a gamma-ray probe, detected a sudden density discontinuity of 20 per cent. The resulting metallic hydrogen, they say, had a density of 1.3.

Metallic hydrogen is important as theoreticians have speculated that it should be superconducting and may be so at room temperatures. But the question then is: Would metallic hydrogen be metastable—ie able to maintain its metallic state after it had warmed up? Obviously it is too early yet to answer that.

The other particular significance of metallic hydrogen is in planetary science. The mean densities of the major planets, Saturn and Jupiter, are so low that they can only be made up largely of hydrogen in one form or another. Whatever density models of these planets you use, the internal pressures must rise to several Mbars and it is therefore highly probable that they contain cores of metallic hydrogen.

Another piece of recent Soviet research—this time theoretical—suggests that it might be possible to dispense with explosive compression to reach the necessary pressures. Argues S. I. Anisimov of the USSR Landau Institute of Theoretical Physics (JETP Letters, vol 17, p 404), a laser pulse of special waveform,

directed at a hydrogen target, could produce several Mbar with only a small rise of temperature. The compression would be nearly adiabatic. Presently available lasers should suffice to produce the necessary pulse energy of 2 kJoule.

Rumours hint that similar experiments in the US, where the subject is under study at the University of California and Cornell University, are also coming to a head and that publication of results is imminent.

Ecological damage wrought by Bronze Age man

An insight into the habits of Bronze Age man in Britain comes from the fossil remains of the beetles with which he shared his habitat. Drs P. C. Buckland and H. K. Kenward, of the University of Birmingham, have recently carried out a study of fossils found at an archaeological site near Doncaster. Many superficially burned tree trunks came to light at this site in drainage ditches. The fossil timber lies at the base of a peat layer, and much of it is "riddled with insect galleries" (*Nature*, vol 241, p 405). At the same level in the peat there is evidence of a primitive trackway made from split timbers. Carbon dating of the timbers gives an age of 3090 ± 90 years, so Bronze Age man must have been active in the region about 1000 bc, making small clearances in the oak forest which then dominated the area, and laying paths through the trees.

But it is not just the oak forest which has disappeared. At least five species of beetle found in the fossilised wood are no longer present in Britain, while others now rare were evidently common 3000 years ago. Although climatic changes are partly responsible, there can be little doubt that human activity and forest clearance hastened the decline of these species. Drs Buckland and

Kenward point out that many of today's species depend on mature forest and are now often reduced to small populations, susceptible to minor environmental changes—in some cases hole up, like Robin Hood, in Sherwood Forest. Some of the beetles associated with rotten wood "must be regarded as endangered animals, not only in Britain but throughout Europe".

Ancient surveying may have been a walk-over

Did civil engineers in the Stone Age possess a uniform standard of length? According to a statistical analysis of the dimensions of many prehistoric stone circles, made by Alexander Thom, the megalith builders used a uniform standard 2-72 feet in length, throughout western Europe (see *New Scientist*, vol 54, p 60, and vol 56, p 636). The conclusion that a standard Megalithic yard was in use 4000 years ago at widely separated sites comes under fire from Hugh Porteous of Liverpool University.

In an article in *Journal for the History of Astronomy* (vol 4, p 22), Porteous criticises the method of statistical analysis used to deduce the existence of a standard Megalithic unit of length. The starting point of the analysis is a collection of circle diameters, established from careful site surveys. Professor Thom has shown that the measured diameters are integral multiples of an exact quantum of length. Not so, says Porteous, who believes that the builders merely paced out the sites before erecting the stones.

The issue hinges on the nature of statistical tests—which tools should be used to chip away at the Megalithic data? Porteous takes the view that the 2-72-ft quantum represents the average Neolithic pace. If anything this pacing hypothesis strengthens the claims for the astronomical achievements of Megalithic man.

Good looking kids do get away with it

It must madden a psychologist when people react to some hard-won research result by simply saying "Well, everybody knows that—that's just common sense." However, you can fairly say that a lot of what "everybody knows" is sheer prejudice, so that it is as well to check such universal knowledge against cold facts. Recently Karen Dion, from the University of Minnesota, has looked into one such tale, which can loosely be expressed as "A pretty child can get away with murder." She found that here, at least, common sense does triumph (*Journal of Personality and*

Social Psychology, vol 24, no 2, p 207).

She asked 243 female students to read an account of a child's behaviour which involved aggression; examples included throwing a stone at a dog, or a snowball at another child. To each account she attached a photo, ostensibly of the child concerned but actually chosen according to physical attractiveness or otherwise. The students then filled in a questionnaire giving their estimates that the child had done something similar in the past or would do so again; ratings on the undesirability of the behaviour; the punishment they thought appropriate, and assessments of the child for such traits as good-bad, kind-cruel, or honest-dishonest.

Their answers showed a definite bias in favour of the prettier children. These came out as less likely to repeat the act; they were considered more honest and less unpleasant than the unattractive children. The latter's behaviour was categorised as less desirable; and the only gleam of hope for them was that the students did not suggest punishing them any more severely.



Can the Pasteur Institute predict the future?

Influenza virus has the inconvenient habit of literally changing its coat with alarming frequency. As a result we humans tend to lag behind in our immunological response to the virus. As soon as we build up antibodies against a specific virus it modifies its coat very slightly, but the change is big enough to allow the virus to escape the lethal attentions of the circulating antibodies; antibody production to the "new" virus therefore has to start all over again. Producing a vaccine against such a capricious virus can be a very frustrating business and has to depend on responding rapidly to each new variant as it comes along (see Man's newest initiative against 'flu, New Scientist, vol 56, p 630). But scientists at the Pasteur Institute in Paris now claim to have anticipated the virus's coat changes and to have produced an anti-flu vaccine that should be effective until at least 1978. If the Pasteur's claims are vindicated the battle against 'flu can switch from defence to attack, but success is by no means certain.

If the alterations in antigenic pattern were entirely random the chances of being able to predict the changes, and therefore manufacturing a vaccine to be effective over a period of years, would be minimal. But the man who put forward the ideas behind the Pasteur vaccine—Dr Fazekas de Saint-Groth, an Australian virologist—points out that 'flu virus's antigenic modifications follow a marked progression. Dr Claude Hannon, of the Pasteur Institute has now collaborated with Fazekas de Saint-Groth in accelerating the antigenic evolution to the state it should have reached in about 1978.

Big and small changes

The major antigenic proteins in the virus coat are haemagglutinin and neuraminidase; of these the former is the more important. Every 10 to 15 years this protein changes dramatically. This very large shift in antigen characteristics catches humans' immunological systems completely off guard and most people succumb to the disease; the epidemics of 1933, 1947, 1958 and 1968 (Hong Kong) were caused by these types of massive antigenic change. As far as our immunological defences are concerned these viruses (A_0 , A_1 , A_2 , A_{2K}) are completely new. Between each major subtype (as they are known) there are slight variations that lead directly (Hannon says predictably) to the next subtype.

The way the subtype changes is central to the ability to look into the antigenic crystal ball. Each variant of a subtype is brought about by the appearance of a single new amino acid in place of an existing one. The mutations result from single base changes in the virus's genome, and this causes an orderly progression of

new amino acids. Moreover, this progression goes from the smallest amino acid (glycine) through to the largest (tryptophan). As each new variant arises it becomes antigenically "senior" to all its predecessors in that subtype. In other words, the antibodies raised against a particular variant are effective against all the variants leading up to that one, but not against descendants.

New variants spring up until no more antigenic changes are possible. This last variant—the dominant form—can provoke antibodies effective against all the variants of its subtype. Once the dominant variant has come onto the scene the pressures of natural selection soon induce the appearance of an entirely new subtype against which existing antibodies are impotent. The selection pressures come in the form of the anti-flu antibodies present in its victims. Once a large section of the population possess antibodies against the "current" variant an antigenic change occurs.

Telescoping time

The Pasteur researchers compress the selective forces that normally operate over a 15 year period into just two years or less by incubating the virus in serum containing hostile antibodies. Once the virus "escapes" from the antibodies Hannon selects the one he believes is most senior, raises antibodies against it and then repeats the incubation. The processes of incubation and selection are continued until (hopefully) the dominant variant is found. The problem is that each time a variant is exposed to hostile antibodies more than one new variant escapes. The success of the Pasteur's project hinges on being able to identify the most senior of the escapees.

The Pasteur team has had their senior A_{2K} variant for about a year now, but experimental vaccine has been available for only a few months. Hannon says that the vaccine is effective against the recent "English 'flu" variant. Moreover, he claims that the antigenic shifts seen in the natural virus during the past year are very much in line with those predicted by his experiments.

So far the prospects for the Pasteur vaccine look encouraging. But could widespread use of such a prospective dominant vaccine actually be self-defeating? Might not the ubiquity of antibodies to even a relatively junior variant (from which it could not "escape") greatly accelerate the evolution of a new subtype? These possible drawbacks, and the inevitable uncertainty about the dominance of the Pasteur virus, are certainly causing a lot of fingers to be crossed in Paris. But if it all works well then the new vaccine would certainly be a great boost to the Pasteur's new status as a financially self-supporting institute.

A magnetisation that results from rotation

Magnetic materials can be magnetised by several means: one is simply to "shake" the sample up by applying an alternating magnetic field while it is also held in a steady magnetic field—called anhyseretic remanent magnetisation or ARM. A new process which somehow produces magnetisation has recently come to light (Geophysical Journal, vol 30, p 295) as a result of a magnetic "cleaning" technique which palaeomagnetists employ. It is the result of just rotating the sample—even quite slowly—while you apply an alternating demagnetising field. The point is that it occurs even when you remove all other external fields. It is thus entirely different from ARM.

Alternating field demagnetisation is useful in removing "softer", unstable components of magnetisation masking older, fossil magnetism of true palaeomagnetic significance. The technique involves putting the sample in zero steady field, obtained by cancelling out the Earth's field with current-carrying coils, and then applying, and gradually reducing, an alternating magnetic field. This procedure brings the magnetic minerals down through a series of decreasing hysteresis cycles. Various workers, however, have noticed that the method usually produces spurious magnetic moments. Assuming these to be due to ARM caused by the difficulty of completely wiping out the Earth's field, they have devised various methods of "tumbling" the sample to average out the effects of any small residual field.

Now, though, it appears that they are bedevilled by a totally unexpected effect. Professor R. L. Wilson and R. Lomax of Liverpool University find that if they rotate a sample in zero field, and apply an alternating field perpendicular to the axis of rotation, a magnetisation results, parallel to that axis, which is substantially bigger (by two orders of magnitude) than a corresponding ARM would be. Moreover, it is essential to rotate the sample to produce the magnetisation. It is not necessary to do so to get an ARM. The sense of the magnetisation is always anti-parallel to the rotation vector (considered to point in the direction a right-handed corkscrew would advance).

The new magnetism which the two researchers term "rotation remanent magnetisation" or RRM, occurred in an alternating field of 50 Hz, slowly raised to 800 gauss and then reduced to zero. Changing only the sense of rotation was enough to reverse the sense of the magnetisation. The strength of the RRM depended on the peak alternating field applied; on the rotation speed (the effect occurred for rotations as slow as 0.02 rev/second, and reached its optimum between 0.1 and 3.0 rev/s); and on the product of the alternating and rotation frequencies.

Wilson and Lomax say that neither gyromagnetism nor normal electromagnetic induction can supply the explanation; possibly it depends on Maxwell's equations applied to a ferromagnetic material.

Copernicus gets a fix on an X-ray source

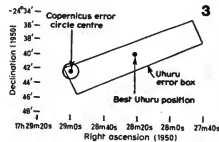
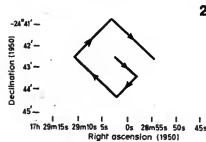
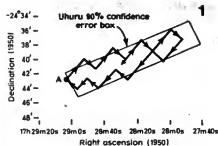
The University College X-ray experiment on board the satellite Copernicus has been used to locate the position of the X-ray source GX 2+5. This work is a classic example of how observations from the survey satellite Uhuru, which sweeps the entire sky finding new X-ray sources and their approximate positions, can be combined with the pin-point accuracy of Copernicus, which is used largely for detailed studies of known sources. Dr F. J. Hawkins, K. O. Mason and P. W. Sanford, of the Mullard Space Science

Laboratory, describe the detective work in *Nature Physical Science* (vol 241, p 109).

Copernicus carries three X-ray detectors which can scan in different energy bands and have positional accuracy of between 3° of arc and 1 minute of arc, depending on the mode in which they are employed.

First, the Copernicus telescopes do a "course scan" of the large Uhuru error box (Figure 1). From this, the observers at UCL deduced that the X-ray emission was coming from close

to point A in the original 26-leg scan. So the telescopes were set to search in a spiral around the point (Figure 2). This fine search showed the position of the source to within a circle 2 minutes of arc across, centred on Right Ascension 17 hr 29 min 0 sec, Declination -24° 42' 19". Compared with the Uhuru position, this is impressive accuracy (Figure 3). But the point, of course, is that both satellites are necessary if new sources are to be found, located accurately, and studied in detail.



Protein affinities pin down the action of penicillin

After a quarter of a century of use, penicillin still retains some mystery. There are many gaps in our knowledge of how it actually kills bacteria, although it has been known for some time that the drug's effect involves the bacterial cell wall. Somehow, penicillin blocks the synthesis of the complex network of protein and polysaccharide that forms the outermost protective coat of a bacterium. Some five years ago, Jack Strominger of Harvard suggested that in *E. coli* it is the enzyme responsible for tying the last knots in this network—an enzyme known as transpeptidase—that is the basic target for penicillin. But this has been difficult to demonstrate conclusively for all organisms; the enzyme has proved difficult to isolate, and in some bacteria there appear to be a number of components of the cell wall which bind penicillin. Some recent work from Strominger's laboratory seems likely to deal with these problems (*Proceedings of the National Academy of Sciences*, vol 69, p 3751).

Strominger has used the fashionable technique of "affinity chromatography" to isolate components of *B. subtilis* capable of interacting with penicillin. Membranes of *B. subtilis* were dissolved in a detergent and the solution was passed over a column of chromatography beads to which penicillin had been attached. Components of the membrane which have the potential for interacting with penicillin, bound to the column, probably by forming a covalent link with the penicillin. Release of these components and their subsequent separation showed that there are no less than five components in the *B. subtilis* which interact with penicillin. One of these

(component V) is the transpeptidase, but this is unlikely to be the real penicillin target. This is shown by the fact that a penicillin analogue, cephalothin, which is lethal to *B. subtilis* like penicillin, only interacts with components II and IV. One of these surely must be the site at which penicillin has its lethal effect. Is the search for the penicillin target over?

Was life forged on this chemical anvil?

Leslie Orgel is one of a brave band of biochemists engaged in the attempt to extract convincing "prebiotic" molecules from laboratory simulations of the primordial soup. With his colleague G. J. Handschuh at the Salk Institute, he has recently been tackling the problem of prebiotic phosphorylation. To have life, you must have DNA; and to have DNA, you must have pentose sugars firmly attached to the bases adenine, guanine, uridine and cytosine, to make nucleotides. Granted a collection of prebiotic nucleotides, you still need a phosphate group to tack on before polymerisation can begin in earnest and the double helix has arrived.

Orgel and Handschuh have addressed themselves to the question of where the phosphate could have come from (*Science*, vol 179, p 483). The favourite so far has been hydroxylapatite ($\text{Ca}_5(\text{OH})(\text{PO}_4)_3$), but because of aspersions cast from a number of sources in its reactivity Orgel and Handschuh have turned to the possibility of struvite ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$), which phosphorylates nucleotides much more readily.

The other point in favour of struvite is that it would easily have precipitated out of the kind of chemical solution which probably comprised the prebiotic oceans. This is important because the polymeris-

ation of prebiotic molecules would have depended on heat, and the best guess is that this came from the Sun shining directly on rock pools at low tide; in which case it would be essential for the chemicals involved to precipitate out of the oceanic solution in the rock pools.

Handschuh and Orgel set up a plausible imitation of a primitive rock pool in their laboratory and found that in their conditions, much more struvite was precipitated than hydroxylapatite. They conclude that if, as is believed to be likely, the primitive Earth was very rich in ammonia, a film of suitable precursor chemicals could well have been left after the evaporation of prebiotic tide pools; and the heat of the Sun on dark coloured rocks could certainly have resulted in nucleotide phosphorylation.

There is one further feature of struvite which has interesting implications for the origin of life, and that is that its ammonium (NH_4^+) group can be largely replaced with potassium (K^+) without disturbing its structure. Orgel believes this may help to explain why, in spite of the huge preponderance of sodium (Na^+) in the environment, all contemporary cells are much richer in potassium (K^+).

He suggests it is possible that the very first cells used NH_4^+ from struvite where modern cells (to most of which NH_4^+ is highly poisonous) would use K^+ . This is not as unlikely as it might seem, because many of the salts formed by NH_4^+ and K^+ are structurally alike. Because the two ions are interchangeable in struvite, the gradual change on the primitive Earth from a reducing to an oxidising atmosphere, with the disappearance of ammonia, could plausibly have been accompanied by a gradual change from cells rich in NH_4^+ to cells which, like those living now, made use of large quantities of K^+ .

Nerves without guide ropes wither and die

Richard Sidman has been working for some years on a number of inbred strains of mouse afflicted with mutant genes known graphically as staggerer, reeler and weaver, which affect various parts of the motor nervous system. Sidman's aim has been to identify the cellular target of these genes by the judicious use of the microscope on the mutant nervous systems at various stages of their development; and weaver now emerges as the consequence of abnormalities, not of the neurones themselves but of supporting brain cells which seem to have a crucial role in guiding the path of the growing nerve cells during development.

Mice which are homozygous for weaver (both genes affected) have extremely abnormal movements and rather weak muscles. The site of the problem is the cerebellum, which in weavers is about one third its normal size. The cerebellum is a particularly convenient place to find a genetic abnormality because it is the one part of the mammalian central nervous system which has an absolutely uniform structure. Jack Eccles, who worked out its complete neural circuitry electrophysiologically, has described it as a "neuronal machine" which monitors and modifies all motor output; neither mice nor men can do without it.

In the course of arriving at the stereotyped cerebellar structure, developing nerve cells of a type known as granule cells have to migrate down from the sur-

face of the cerebellum to reach the correct layer. The granule cells, according to Sidman's microscopy, reach their proper positions by sliding down long processes put out by brain cells known loosely as glia, vaguely described as supporting cells, the exact function of which is unknown. However, these particular glia (Bergmann glia) evidently have an important function, at least during development, because they are absent from weaver cerebella; and in weaver cerebella, the granule cells do not migrate to their proper positions. They stay at the surface and die.

Now Sidman and his colleague P. Rakic at Harvard have taken a look at weaver heterozygotes, in which only one gene is abnormal, and have been able to show, for the first time in a mammalian neurological mutant, an effect of gene dosage (Proceedings of the National Academy of Sciences, vol 70, p 240). The heterozygous mice are slightly smaller than normal but have apparently normal movements. Their cerebella do contain Bergmann glia, but the guiding processes of the cells are distorted. Although a fair proportion of the granule cells of heterozygotes manage to find their way down to the correct layer, some are left behind, and, as in the homozygotes, these die.

Armed with these genetic dose-response data, Sidman may now be able to fill in the remaining link at the very beginning of the chain of interacting events in the developing cerebellum: the factor that controls the development of the Bergmann glia.

Astronomers ensnared by the galactic whirlpool

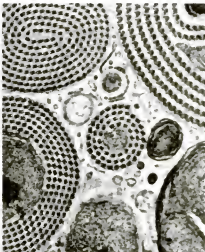
The elucidation of the spiral structure in our Galaxy is one of radio astronomy's major achievements. Now that the honey-moon is over, however, students of galactic structure are finding it hard to agree on the outer precincts of the Milky Way. Recently Monitor (vol 56, p 688) outlined one view, expressed by Dr R. D. Davies (Jodrell Bank), that the fringes of the spiral arms may be linked physically to the mysterious high-velocity clouds (HVCs) of hydrogen. Several important papers in the latest issue of Astronomy and Astrophysics (vol 22, p 1-160) set out arguments for and against this hypothesis, without reaching any final conclusions.

Three mathematicians at the USSR Academy of Sciences, T. M. Eneev, N. N. Kozlov, and R. A. Sunyaev, take up the general question of the tidal interaction caused by a close encounter of a galaxy and massive object (see also Monitor, vol 57, p 174). The ensuing tidal battering sucks stars out from the galaxy and creates short-lived spiral structure. Under some circumstances matter is enticed away from the galactic plane, only to go crashing back after a brief affair with the passing object. The subsequent warping of the plane and creation of high-velocity clouds are similar to those seen in the Galaxy. So the Russian work is consistent with the hypothesis that the HVCs were ripped away from the Galaxy by the Large Magellanic Cloud some 4.5×10^6 years ago.

G. L. Verschuur (National Radio Astronomy Observatory, West Virginia) sets down a comprehensive model for the spiral structure on the galactic periphery. Basically he agrees with Davies' view that the high-speed hydrogen mapped by radio telescopes represents a considerable extension to the outermost arms. In radio maps arch-like formations of hydrogen can be traced to large angular distances above the "pancake" of the Milky Way. He demonstrates that these are contiguous with the arms, and their high velocity is said to be a consequence of their great distance from the centre of rotation, and not due to an infall of matter.

Jan Oort, the grand old man of galactic structure, and A. Hulsbosch strike a discordant note. They agree that the high-speed gas at low latitudes could be far-flung appendages of the spiral arms, but claim that this interpretation is impossible at high latitudes. Instead they return to Oort's long established hypothesis that the HVCs are clouds of galactic hydrogen that are being rammed down into the plane by pressure in the intergalactic medium. They thus have nothing very much to do with the spiral structure.

One consistent theme to emerge from these recent studies of HVCs is that the problems will not be resolved until we know more about the nature of galactic rotation at large distances from the galactic centre. This requires a lot of effort on the part of radio and optical astronomers.



($\times 28\,500$)

Thrashing out differences in cilia

There is one kind of internal structure that predominates in the immense variety of cilia and flagella, the specialised cell structures that have evolved to give cells the ability to propel themselves. In cross-section, the cilia and flagella from most microorganisms and animal cells have a circular arrangement of nine microfilaments surrounding a pair of "microfilaments" at the centre of the circle. This arrangement is so widespread that any exception is remarkable—the micrographs here represent such an exception. They are of cross-sections through the flagellum of a spermatozoon of the fungus gnat *Rhyncosciara*; instead of the 9+2 arrangement, the "propellor" of this cell consists of hundreds of double microfilaments. The microfilaments are wrapped around the source of energy for propulsion, a modified mitochondrion which runs the whole length of the flagellum. What the picture cannot reveal, of course, is whether the spiral differs from the standard arrangement of microfilaments in the motility it can confer. And if so, how and why?

A day in the life of a vampire

Vampire bats, as any Hammer Films addict knows, suck blood from the necks of nubile young women who have been foolish enough to go to sleep in castles with the windows open. In fact, as readers of the current *Journal of Zoology* (vol 168, page 451) will by now have discovered, vampires really come from tropical Latin America, where they bite folks on the leg, cows on the nostrils and human beings usually on the big toe. There are no reliable data on vampires' ability to implant bizarre sexual urges in their victims, but plenty on their tendency to infect people with rabies. Arthur M. Greenhall of the Smithsonian Institution, working in Mexico as part of a FAO-UNDP project on paralytic rabies, studied the feeding habits of the common vampire bat *Desmodus rotundus*. He watched it pursue luckless mice and guinea pigs around a laboratory cage and, with the aid of US Army infrared sniperscopes, observed it lapping up the blood of somnolent cattle in the open fields. The behaviour and morphology he describes are elegant enough to leave Darwinians lost in admiration, and repulsive enough to give the imaginative bad dreams for a fortnight.

Desmodus has reached pest status in Latin America because of the easy prey offered to it by domestic livestock. The vampire likes to feed where capillary blood vessels are abundant and near the surface: on a cow's ear for example. Sometimes it bites so furiously that it completely severs the muscle, and the ear is

found hanging limply down in the morning. The cleft at the back of the hoof is another favourite spot on cattle, horses and mules, while water buffalo, which spend the night with only their muzzles unsubmerged, are often bitten on the nostrils.

A close shave

Vampires can spend well over half an hour selecting a biting site on a new animal, although they will reopen an old wound in a few minutes. The first action is for the bat to moisten the victim's hair with saliva, which involves licking it for 10 to 40 minutes. Then the vampire opens and shuts its mouth repeatedly, probably honing up its long razor-sharp upper incisors against two deep scabbard-like pits in the lower jaw. The inner, bevelled edges of these teeth are then employed to shave away hairs or feathers, the bat either using one tooth repeatedly with a sideways motion, or each tooth alternately so that its head appears to wag from side to side. When it reaches the hide, the vampire may continue the same shaving operation until several layers of surface skin have been removed and the capillaries are exposed. When the feeding area is prepared to its complete satisfaction, the bat grips its victim firmly with its bilobed lower incisors, opens wide its jaws and makes a downward power stroke with the upper teeth, scooping out a neat chunk of flesh in the process.

This meaty divot, 3-4 millimetres across and up to 5mm deep, is carefully placed on one side. Should the

flesh prove unusually tough, the upper and lower canines may be used like a pair of shears to enlarge the wound, and as the jaw closes and the incisors anchor into the flesh, the cheek teeth scythe past one another in a scissoring motion, cutting through any especially troublesome muscle. The whole process normally starts a copious flow of blood, which is sucked up through a pair of tubes rather like a child slurps up lemonade from the bottom of a glass. A couple of grooves on the sides of the tongue join with corresponding grooves in the lower lip to form a pair of drinking straws, which lead to the back of the mouth. The vampire's tongue moves rapidly in and out during drinking, each lap apparently transferring to its throat the blood which it has first sucked into its tongue tubes. It may be an hour or more before the vampire's thirst is slaked.

The tongue, which even when the jaw is closed, slides easily in and out through a space between the lower incisors, has roughened sides which can rasp around the edges of an old wound to restart the blood flow. There is also some evidence for a completely different type of bite, in which the hard horny tip of the tongue punctures the skin and bores into the flesh, filling the hole afterwards with a plug of soft, greyish matter.

Maintaining the blood flow

Physiologically, the vampire has several useful adaptations. Unlike Count Dracula, it does not curdle the blood of its victims, but lets an anticoagulant trickle with its saliva into the wound. Consequently the hole will keep blood for many hours, often attracting insects to feed and lay their eggs in the hole. There is some evidence that vampire saliva also contains a depilatory agent: this prevents hair from regrowing around the margins of a wound, and facilitates future meals from the same victim.

Desmodus, the vampire studied by Greenhall, remains puzzling in several respects. How do other teeth besides the incisors remain sharp enough to cut into a victim's flesh without wakening it? Is there perhaps an anaesthetic in the saliva? What is the function of the lingual glands, from which a groove joins the sucking tube along the tongue?

Equipped with three sets of self-sharpening teeth for slashing, gripping and scrunching respectively, the vampire first washes and shaves the wound site, then slices off the skin, shears through any bits of gristle it may find, and finally scoops out a dripping divot of flesh. As its tongue punctures, digs, rasps, sucks and laps up blood, it drops in anticoagulant and perhaps depilatory and anaesthetic agents as well. Mercifully, *Desmodus* has an overall length of only 3 inches.

Jon Tinker



The uneven incisors of *Desmodus*. Note the space between the upper and lower incisors to permit the passage of the tongue. (magnified $\times 35$)

Everybody in my laboratory has his own desk-computer.

The WANG System 400 Multiple User programmable calculator

If you have a computer terminal in your laboratory you have queues. If you use a mini-computer you still have queues.

Result: your people aren't getting the computing help they need. Solution: a multiple-user installation of Wang System 400 advanced programmable calculators. Each unit operates independently. Each unit has real computing capacity. And the system is priced at a level that means you can equip every bench in your lab.

What can System 400 do? The units are streamlined versions of our larger calculators, and incorporate all the most-used features. Three different models have pre-programmed functions: mathematical functions for scientists, maths and trigonometry for engineers, and for statisticians a whole range of powerful functions including multi-variate regression analysis.

The basic unit has a 12 digit display with scientific or floating point notation. In addition to the normal

calculator keys, System 400 has 16 "special" keys. These, in turn, access 16 storage registers each with full arithmetic capability; control the 16 for 32) preprogrammed functions; and control 16 different program routines specified by the user. That way each unit in System 400 can be adapted by individual users to solve their own particular problems. In addition each unit can hold up to 64 learn-mode program steps (expandable to 320 steps or 40 extra registers). In learn mode users program "live" using all the built-in functions of the machine. System 400 installations cost from £415 a unit.

WANG

The complete range of Calculators and Computers.



For single unit applications, WANG have a complete range of programmable calculators, mini-computers, and peripherals. However simple or complicated your problem, WANG has the right calculation system for you.

- ☐ Please send me more information on :
 - ☐ Wang System 400 Multiple User desk computers
 - ☐ Wang 600 Programmable Calculator
 - ☐ Wang 2200 basic Programmable Calculator

- ☐ Please arrange for a demonstration in my office

My name _____ Position _____

COMPANY or ORGANISATION _____

Address _____

Tel n° _____

Return to WANG ELECTRONICS Ltd., 40-44 High Street, Northwood, Middlesex. Tel : Northwood 27677. Telex 922.161.

Breeding bulls for higher steaks

To satisfy the world's craving for beef, tomorrow's breeders may have to produce massive cattle, very different from today's classic beef breeds . . .

Dr David Allen

is head of beef improvement services, the Meat and Livestock Commission, Bletchley, Bucks

The current world shortage of beef emphasises the need to increase the weight of meat from each beef calf; yet modern intensive production methods reduce not only the age at which cattle are slaughtered, but also their slaughter weight. The problem faced by all beef producers is how to raise cattle intensively and yet keep them large. The solution could transform traditional ideas of what makes a beef animal. The classic, traditional British beef breeds—Aberdeen Angus, Hereford, and beef Shorthorn—which are generally castrated and raised as steers, will face increasing competition from relatively massive animals based on European breeds, and raised as intact bulls.

The aim of any system of production is to produce a "finished" animal—one with an acceptable ratio of lean beef and fat. This ratio changes as an animal matures: when young, growth is largely concentrated in the skeleton, so young animals tend to be bony. With the skeletal frame reasonably well established, muscle development is emphasised. Finally, the proportion of fat increases.

Cattle were at one time raised in "extensive" systems in Britain, and still are in most parts of the world. They were allowed to graze relatively low-grade pasture over a wide area, putting on weight in summer, remaining relatively static in winter (or, in other parts of the world, in times of drought). Such cattle grew slowly, and took several years to "finish". Economic pressures—not least the price of land—no longer allow such leisurely beef production systems in Britain. The trend in recent years has been to intensify: animals are fed on high-grade grass or grass products, or on barley, and they "finish" in one to two years, depending on the system adopted. But animals finished in less than two years are smaller than they would have been if allowed to develop more slowly; they simply do not have time to develop large skeletons, and they begin to lay down fat at a young age. Hence, because of the intensification of cattle production systems, beef animals now "finish" at lighter weights than was once the case. And, in general, for a given kind of beef animal, the more intensive the system, the smaller will be its finished weight. Hence intensification actually reduces the output of beef per calf.

We can illustrate this by reference to Britain's commonest breed, the black-and-white Friesian. This animal, besides being the mainstay of the dairy herd, is also a major source of calves for beef. Friesian steers (castrated males) gain 2.5 lbs per day when fed on barley, which is a high energy diet. At 11 months of age they are fat enough to be deemed "finished", but their carcasses—that is, after skin, offal and so on are removed—weigh only 475 lbs. When raised on high quality grass, with silage in winter, the

same animals would put on 1.8 lbs per day and would be slaughtered at around 18 months, producing carcasses of about 550 lbs. A further extension of the production cycle to two years would produce a daily gain of 1.5 lbs and a carcass weighing around 620 lbs.

Why not simply continue feeding the barley-fed animal until it has reached a more desirable weight? Further feeding of an animal that has already started laying down fat merely makes it fatter. This not only reduces the carcass value—as the public now demands lean beef—but is also an extremely inefficient way to put on weight. A beef animal needs to eat about seven times more feed to put on a pound of fat, than to put on a pound of lean. The graph shows how the feed cost per lb of gain increases at an accelerating rate as cattle get bigger and fatter.

How, then, can intensification be reconciled with the need to produce bigger finished animals? The inherent characteristics of cattle are of crucial importance. Among cattle of a single breed, there are large variations in growth rate, feed conversion efficiency, and carcass fatness. This variation continues and extends between breeds and crossbreeds. It is also affected by sexual status.

Continental producers view the British habit of castrating bull calves with curious amusement, and themselves produce beef from intact bulls. They argue that bulls produce more lean beef more efficiently. Records collected by the Meat and Livestock Commission (MLC) in barley beef units support this view. Bulls had daily gains 13.4 per cent higher than steers and a feed cost per pound of gain 10.6 per cent cheaper. The bulls were slaughtered 19 days sooner than steers and produced carcasses 17 lbs heavier. These improvements in performance are estimated to increase the financial margin by £8 per head.

MLC trials, conducted with the cooperation of commercial farmers in Britain, suggest that equivalent gains can be expected with 18-month grass-based systems. The semi-intensive bulls grew faster, could be slaughtered at heavier weights, and produced leaner carcasses than steers. The farmers reported few management problems—such as aggressive behaviour—and the bull beef had acceptable eating quality.

But in Britain, government regulations originally designed to prevent farmers keeping genetically inferior animals for breeding purposes, now make it extremely difficult for them to raise entire bulls for beef. Obviously, a specialist approach is necessary to bull beef production, but its advantages are sufficient to suggest the regulations need review.

A second, rapid method of improving growth rate, feed efficiency, leanness, and size, is to use breeds that already have those

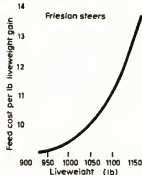


Figure 1 The relationship between liveweight gain and feed cost per lb of gain during the winter feeding of semi-intensive beef (source, MLC)

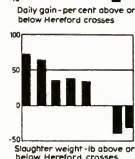
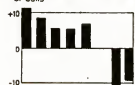
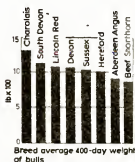


Figure 2 The comparative performance of bulls and steers in semi-intensive beef production (source, MLC)



The shape of beef to come? Italy's Chianina, probably the largest domestic cattle breed in the world, is on its way to British farms



A hundred generations of selective breeding went into the production of this paragon of beef, a champion Hereford. But such animals suddenly seem old-fashioned: quite simply, they are too small



The Charolais, from France, was the first of the giant European "draught" cattle to make an impact on British beef breeding

characteristics: to take the improvements "off the peg". One could not expect to find all those desired characteristics together—the genetic relationship between them is probably complex. But generally the faster growing breeds are also later maturing—that is, they are less fat at any weight—and correspondingly, they produce heavier carcasses at a given external thickness of fat cover. Figure 2 shows the closely related rankings of weight for age in pure bred cattle of the sire breeds, with daily gains in crossbreeds sired by them, and the slaughter weights of those crossbreeds. The Charolais not only has the highest 400-day weight of any breed recorded in Britain, but also, when crossed with commercial suckler cows, produces calves that have slightly higher growth rates and slaughter weights than those produced by Britain's biggest native breed, the South Devon. In those characters, Charolais's superiority over the classic British beef breeds—Herefords, Beef Shorthorn, and Aberdeen Angus—is even more marked. As a result the Charolais has, since its importation from France in 1961, established itself as an important beef breed in Britain and continues to extend its influence.

The Charolais was the first of the continental European breeds imported into Britain for beef production. At that time government sanctions were strict and importation was permitted only if the breed offered potential benefits to the efficiency of home beef production. Further, the new breed had to be evaluated competitively against native breeds. It was under these regulations that Limousin cattle were subsequently imported from France and Simmental cattle from Germany and Switzerland. A change of government policy now permits the importation of any breed provided that veterinary security is achieved.

The change of policy has brought most of the continental European breeds under scrutiny for possible importation into Britain. Attention has been sharpened by the world interest in these breeds, especially in North America and Australasia, and the fact that Britain's unique health status makes it easier for these countries to import cattle from Britain than from the breed's country of origin. Indeed, the needs of this lucrative trade become confused with those of improving the efficiency of home beef production. The continental breeds under examination are of moderately large or large body size and produce carcasses with a dramatic muscular shape and a high lean beef content. Some breeds, such as the Simmental, have a dual purpose, milk and beef background, though they are imported for their beef potential. With more than two dozen breeds likely to be imported, it is a safe guess that few will actually become sufficiently established to have any real influence in Britain. Also, an educated guess suggests that none of the breeds will promote more rapid live-weight gains than the Charolais.

However, Italy's Chianina, whose importation is now in hand, is taller and has an even higher mature weight than the Charolais.

Bulls can stand 6½ feet at the shoulder, and some weigh 4000 lbs. Commercially, it should be possible to produce one-ton Chianinas at the age of two years, with lean carcasses of well over 1000 lbs.

Cynics describe these huge breeds as "the draught oxen of Europe". But it is because those animals were—and in some places still are—used as draught animals that they are now in demand. Breeders sought to develop muscular power and shape, and inevitably, but accidentally, produced the kind of large cattle that are suited to many of the modern systems of beef production. By contrast, the British breeders developed beef animals at a time when horses were used for draught power. Cattle were expected to produce carcasses fatter than those required by today's trade even from low quality winter feeds. This, together with a refinement of body shape, caused the classic British breeds to be smaller and fatter than the continental types. When used in the most intensive of today's production systems, they produce carcasses which become overfat at very low weights.

On such an analysis, the continental breeds should displace the native British breeds, although inseminations from Hereford bulls still outnumber those from Charolais bulls by

over four to one. And the numerically smaller British breeds, such as Devon, Lincoln Red, Sussex, and South Devon, which have retained good weight for age, are enjoying a period of popularity unprecedented in recent years. One reason for this is that the large calves produced by large bulls tend to cause more calving difficulties, and hence more neonatal deaths, when crossed with cows of smaller breed. These problems are intensified when size is combined with bulging muscular shape, as in the Charolais, but reduced when the large animal is long and relatively narrow, as with the South Devon and Chianina.

What of the future? Breeds such as Aberdeen Angus, which have been criticised for lack of size, are being bred larger and leaner. But so, too, will the Charolais and South Devon. Calving difficulties need not set a limit on size, provided size is not combined with short, thick, body form. There are those who believe that above a certain size cattle would become physiologically unstable. However, even with the most intense selection weight can be increased by only about 1½ per cent per year, which gives ample scope for reappraisal. For the next few decades, pursuit of yet more bulk could rank high in breeders' priorities.

Dropping the tracked hovercraft

The outlook is gloomy for Britain's air cushion supported high speed transport system—the tracked hovercraft. The government will decide within days whether to kill or extend the programme, which lacks a customer and is probably the wrong technology

Richard Hope
is editor of
Railway Gazette

The fate of Tracked Hovercraft Limited will be announced in a few days. There is nothing left of the £1.75 million invested in THL 18 months ago, and the 150-strong team at Cambridge and Earith must be paid or disbanded. The National Research Development Corporation report on its subsidiary's prospects was sent to DTI last month.

Having spent £5.25 million so far, THL has only completed the first phase of its attempt to produce a viable tracked air-cushion vehicle (see "Hovertrain comes on pace", by Glen Lawes, New Scientist, vol 47, p 68). Tangible results to date are a mile of concrete test track pointing hopefully north-east from Earith along one bank of the Old Bedford River and RTV 31, a 21-ton unmanned test vehicle.

THL's immediate need is for £4 million to extend the track by two miles, allowing RTV 31 to attain 250 km/h in comfort—rather than the fleeting 172 km/h reached on 30 January—and to keep the project team together for another three years.

Unfortunately no serious customers for tracked hovercraft are in sight. Despite recent rumours British Rail, the nation's principal operator of guided ground transport, sees its own advanced passenger train (APT) as the most promising line of development for the immediate future, with perhaps 400 km/h as the limit for steel wheels on steel rails. The

BR view of tracked air cushion vehicles (TACVs) is shared by the French Railways, which will have nothing to do with Jean Bertin's Aerotraine (New Scientist, vol 51, p 368), and is currently pressing the government hard for permission to build a new 300 km/h railway between Paris and Lyons.

Advocates of the tracked hovercraft have made much of THL's one possible customer, the Canadian province of Ontario. But this is only for linear motor technology and not the high speed air cushion system. The objective is to produce a new form of light rapid transit for the less busy corridors in the Toronto area. The two candidates are the rubber-tyred Hawker Siddeley Minitrain with magnetic-levitation (mag-lev) system. But there are serious questions as to whether light rapid transit needs this sort of new technology at all.

Big future for high speed

High speed ground transport, however, demands new technology, and there appears to be a big future for 500 km/h guided ground transport in the world's more densely-populated and industrialised regions. It is THL's prospects of beating the competition in this market that the DTI must consider.

As a TACV system, the British version shows up well in comparison with its US and French counterparts. The British box-section



Figure 1 Cutaway view of hovertrain proposed by THL to the US Department of Transportation

track structure is very economical compared to the inverted-T adopted by the French, and the U-shaped trough which the US Department of Transportation (DoT) is installing at its Pueblo test site in Colorado.

Because TACVs require a continuous elevated structure, the track cost is a very high proportion of total costs and hence track shape reflects significantly back into fares. A study carried out by THL for the US DoT in 1970 gave costs per passenger-mile of 3-62p, 2-97p, and 2-45p respectively for the US, French, and British track configurations in a common traffic situation.

THL's vehicle will compete favourably with other TACVs. But two questions have to be answered before we go ahead with developing new transport systems: Are major hovertrains of any kind justified while we are far from the end of development of our existing railways? And if a sound technical and commercial case can be demonstrated for abandoning steel rails, should support and guidance be by air cushion or magnetic levitation?

Limits of railways

Three hundred kilometres an hour is commonly quoted as the upper speed limit for railways. The gradual loss of "adhesion" between wheel and rail as speed rises limits the propulsive power that the wheels can transmit. However, linear motors, necessarily specified for hovertrain propulsion, could easily power trains as and when adhesion becomes inadequate.

For guidance, steel wheels have a significant advantage in that a properly-designed rail vehicle will steer itself through curves. This guidance requires no direct power input and does not fail when a fuse blows. The TACV's guidance, air cushions acting on the sides of the beam, are elaborate and costly by comparison.

Where support is concerned, the picture is

much the same. Wheels are cheap to install and the energy absorbed by rolling friction is negligible compared to aerodynamic drag in the 300 to 600 km/h range. The only serious doubt about this system is the way in which dynamic forces between rail and wheel increase sharply with speed, so that very smooth and expensive to maintain track could be needed above 300 km/h.

There is, however, a definite limit to the speed that will ever be commercially justified on the Earth's surface, unless we resort to evacuated tubes. Air resistance rises dramatically as speed increases, so that a train which requires, say 3000 kW for propulsion at 200 km/h needs 17 000 kW at 400 km/h and 130 000 kW at 800 km/h. Above 500 km/h the physical problems of accommodating the power and control equipment on the vehicle become impracticable.

Air systems power hungry

Even assuming that there is still a commercially-viable speed zone between 300 and 500 km/h in which—for some reason not now apparent—wheeled vehicles cannot operate satisfactorily, the TACV still has to show to advantage compared with magnetic levitation (see following article). And here we come to the real crunch, because it is obvious that mag-lev development is rapidly overtaking air cushions, mainly because less power and lighter vehicles are required.

One THL study calculated the power required by a 100-passenger 40-ton vehicle able to travel at 400 km/h in a 70 km/h crosswind. It was estimated that aerodynamic drag would absorb 2800 kW and momentum drag, 2100 kW. (Momentum drag is the kinetic energy needed to take on board the air required for hoverpads and to accelerate this mass up to vehicle speeds, and naturally does not occur with mag-lev vehicles).

Thus a 4900 kW linear motor would be required, which for economical operation would need a three-phase power supply with both variable voltage and a variable frequency. Unfortunately, a modern 4500 kW electric locomotive, carrying no passengers and only voltage control equipment, weighs 80 tons.

THL's solution is to place electrical control gear in the lineside substation and vary the voltage and frequency of power supplied to the three conductor rails on the track according to the requirements of the train at the moment. This means that the distance between trains must be greater than the distance between substations, a very expensive answer if frequent service is expected.

Another way to lower weight is to eliminate the fan systems. The weight of various components of a mag-lev and air cushion vehicle are essentially the same—the magnets have roughly the same weight as the hoverpads, for example. The fans and their motors, however, constitute 15 per cent of the weight of an air cushion vehicle and have no comparable unit on a mag-lev system. With expected payloads being only 30 to 40 per cent of the vehicle weight, eliminating fans and using the smaller linear motors needed if

Figure 2 Tracked Hovercraft Limited experimental hovertrain on the THL test track at Earith, Hunts



there is no momentum drag could well mean that a mag-lev vehicle would have twice the carrying capacity of an air cushion one.

In addition, the THL study estimated that 2200 kW would be required to levitate the vehicle. Mag-lev would require considerably less—possibly as little as 40 kW if German estimates are correct.

Finally, there is the noise problem. Ear-muffs are recommended when RTV 31 is airborne, while mag-lev should be much quieter.

Mag-lev is still at an early stage, but on the evidence currently available it seems clear that the real choice for high speed ground

transport lies between steel rails and mag-lev. THL has done some work with mag-lev and now concedes privately that mag-lev seems the way to go. But the Germans have an almost insurmountable lead here. As Britain is already well placed to compete on steel rails with the APT, this is probably the best horse to back.

But THL has developed an important expertise in linear motors that should not be lost. Both BR and Hawker Siddeley have expressed interest in the aspect of THL, so perhaps this segment could be spun off to one of them.

Magnets boost high speed trains

Trains floating 30cm above the track on superconducting magnets and running at 500 km/h may be operating by the end of the decade. Magnetic levitation now seems superior to air cushions at high speed and development activity has increased sharply in the past few months

Joseph Hanlon

When high speed transport was first seriously considered 10 years ago, air cushions seemed the only way to beat friction and track induced vibration. Magnetic suspension, which offers a totally quiet system with no moving parts, did not seem practical. But four magnetically suspended test vehicles are now operating in three countries. Late last year, both the Japanese National Railways (JNR) and Stanford Research Institute (SRI) began operating vehicles supported by superconducting magnets. And recently, the Wolfson Foundation gave £274 000 to researchers at two British universities to build magnetically levitated (mag-lev) vehicles.

Magnetic suspension was suggested early in the century—a patent was issued as early as 1912—but the systems were never considered seriously until high speed transport finally demanded it. Three technological developments made mag-lev possible: lightweight vehicle bodies; superconducting magnets; and reliable solid state systems for controlling and switching large amounts of power rapidly.

Magnetic force can be used in two ways; the repulsion of the like poles of two magnets or the attraction of a magnet for steel or

iron. Both are used to suspend vehicles, and neither is as simple as first appears. Attraction is intrinsically unstable and requires complex control circuitry. Repulsion is stable but requires vastly larger fields, so that superconducting magnets are a must, and the complexity of cryogenics is introduced.

Attraction in Germany

The first entries into the mag-lev race were two German companies, Krauss-Maffei (KM) and Messerschmitt-Bölkow-Blohm (MBB), and a US firm, Rohr. All chose attraction systems and had low speed test vehicles operating in 1971. Dr Bhalchandra Jayawant and Dr Alex Hazelrigg at Sussex University have just received £127 000 from the Wolfson Foundation to develop attraction vehicles. MBB and KM are both working on high speed vehicles; the Sussex team, Rohr, and KM are developing magnetically suspended personal rapid transit (PRT) systems, horizontal lifts carrying 4 to 30 passengers at low speeds for short distances (see *New Scientist*, vol 54, p 429).

All of the groups use electromagnets to pull up toward a steel rail—an inherently unstable situation because the magnet wants to pull onto the rail and force increases as the magnet

Figure 1 Proposed University of Sussex magnetic attraction urban transport vehicle, with separate levitation and guidance magnets

Figure 2 Krauss-Maffei combines guidance and levitation in one magnet

Figure 3 Power in attraction magnets is controlled by carefully measured pulses of positive and negative voltage

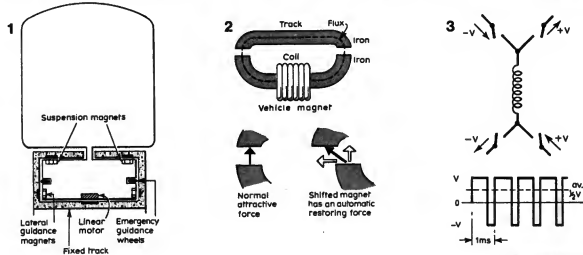




Figure 4 MBB experimental 6-ton magnetic attraction vehicle, showing the copper linear motor reaction rail (1), L-shaped steel magnetic reaction rail (2), magnet-rail gap sensor (3), and lift magnet (4). Guidance magnets are hidden behind the vertical part of the L rail

Table 1

Projected component weights (in kg) of Sussex 6½-tonne low speed mag-lev vehicle	
support magnets	550
guidance magnets	550
sensors, amplifiers	50
inverter to convert a.c. power to pulsed d.c.	600
60-kW linear motor	1000
vehicle shell	750
30 passengers @ 100	3000
	6500

gets closer to the rail.

All except KM use similar attraction magnets pulling on vertical steel plates for side-wise guidance and stability. KM, however, uses a C-shaped magnet that has a natural restoring force (see Figure 2).

The magnetic force is regulated by carefully controlling the voltage in the electromagnets by a mixture of rapidly pulsed (1 kHz or higher) positive and negative voltage. The relative lengths of the positive and negative pulses determine the average voltage in the windings. In unusual situations, such as roughness in the track or a sudden crosswind, voltage up to 10 times normal can be added to the magnet windings to force the magnetic field to change quickly (see Figure 3).

Inductive sensors constantly measure the gap between magnet and rail and feed data to the magnet controls. Because the Sussex team is working on small PRT vehicles carrying only 30 passengers, they can use transistor amplifiers to control the magnet power. The Germans, with larger, heavier, long distance vehicles, need more power and are forced to use potentially less reliable thyristors.

The complex electronics required by these systems has raised some eyebrows, but solid state electronics are extremely reliable, and Jayavant argues that their reliability can be improved even more at low cost simply by introducing duplicate systems.

The second problem, however, is more controversial. In order to keep magnet weight at a minimum—a critical problem as Table 1 shows—the vehicles must have as small magnets as possible, and thus a small gap between magnet and track. All have chosen gaps of 10 to 20 mm and expect magnet power required to be near 1 kW/tonne. The difficulty is that the small gap requires extremely smooth track and a very high and expensive maintenance standard. Dick Giles of Tracked Hovercraft Limited agrees that its running rail was produced to the tolerances required for such use—less than 3 mm sag in the 22 m between support columns and a difference between adjoining track sections of less than 3 mm.

But others are less sanguine. Dr Howard Coffey, head of SRI's mag-lev programme notes that Japanese National Railways had so much trouble with settling on its high speed Tokaido railway line that even nightly maintenance could not keep track smooth enough and top speeds had to be cut from 240 km/h to 200 km/h. Proponents of attractive systems argue that wheel-rail contact forces caused much of the trouble, and that these do not exist in mag-lev. So the issue remains unsettled.

High lift with cryogenics

If rough track really is going to be a problem, the only answer is to fly high above the track. A repulsive system using superconducting magnets will do this and with significantly less weight, but probably with higher cost and its own form of complexity.

Conceptually, the simplest system would have magnets in the track and magnets on the vehicles which repel each other. It is simpler, however, to use conducting coils—typically aluminium doughnuts—as the track. When the vehicle's magnets pass overhead, they set up eddy currents in the coils which in turn set up a magnetic field. The two magnetic fields then repel. In practice, one can also use aluminium sheets and the eddy currents and repulsive magnetism are also set up. JNR employs coils and SRI uses the continuous sheet. Superconducting magnets are so strong that gaps between magnets and track are expected to be 15 to 30 cm, 15 times larger than with attractive systems.

Repulsion systems have several serious problems. Because the image magnet is created in the track only when the vehicle is moving, there is no lift at low speed. Thus, up to speeds as high as 75 km/h the vehicle would have to ride on an auxiliary wheel system. Tracked Hovercraft's technical division manager Michael Charity commented: "Wheels are a menace. We've had as much difficulty with wheels as with anything else."

Second, the eddy currents create not only repulsive magnetic forces, but a magnetic drag which tends to hold the vehicle back. In effect, the system creates a linear motor that works against it. In a study for the US government, Ford Motor Company estimated that for speeds above lift-off magnetic drag was constant and for a 50 tonne vehicle would be equivalent to constantly fighting a 300 km/h headwind! Aerodynamic drag rises so rapidly with increasing speed, however, that at high speed magnetic drag is relatively less important. According to Ford, to move the vehicle at 500 km/h would require 3.6 MW to overcome air drag, and 1.2 MW to overcome magnetic drag.

Finally, there is the problem of the cryogenics. Liquid helium would be required, and no cryogenic system yet built can undergo the day to day life of a transport system.

A major advantage of superconducting magnets is that once energised, current continues to flow with no power input. Thus a typical superconducting mag-lev system would cool and energise the magnets only at terminals. There would be no refrigeration equip-

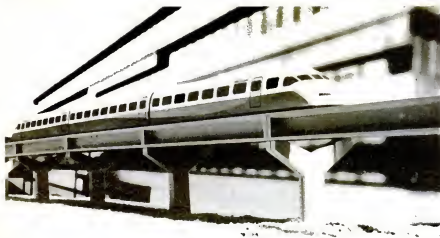


Figure 5 Model of MBB's proposed high speed mag-lev train

ment on board and only a small tank to collect the helium that boils off during the trip. Most groups working with superconducting magnets extend this one step further to a vehicle that requires no running power at all. They put the linear motors on the track instead of the vehicle (significantly raising already high track costs) and put either a metal plate or another superconducting magnet on the vehicle as the motor reaction plate. This eliminates the need for high speed power pick-up, still a difficult problem, and significantly reduces weight. Dr Rene Rhodes of Warwick University, who has just received £147 000 from the Wolfson Foundation, estimates that the magnets and cryogenic systems for a 30-tonne 100-passenger vehicle would weigh only 4 tonnes, giving it a significantly larger payload than any other high speed system.

One other repulsive system is also under consideration. Professor Eric Laithwaite, widely known for his work on linear motors, announced on 2 February in a lecture at the Royal Institution, London, an electromagnetic repulsion system developed for Tracked Hovercraft Limited. The same magnets both lift and propel and can operate on 50 Hz ac power, so they require no special rectification equipment.

Despite its announcement at this time, the motor is still an unknown quantity and most experts are highly sceptical. Laithwaite has only done simple tests—levitating and moving a piece of aluminium over a set of magnets—and has apparently done no calculations to show if the system can be scaled up to a full size vehicle. There are real questions about this; electromagnets were abandoned early on for lift because they are so heavy. The idea is intriguing, but will require considerable additional work to demonstrate its practicality.

Contest continues

There is a serious contest building up between attraction and superconducting repulsion systems for high speed vehicles. Each side finds the other system intuitively distasteful and intrinsically unworkable.

Track represents half the cost of any high speed system and both the extremely smooth track for the attraction system and the linear motors in the repulsion track will be very expensive. And neither side has yet studied the

effect of track roughness at high speed.

Laithwaite argues that attraction systems are essentially magnetic and that "magnetic machines get better as you make them smaller and slower" while repulsion systems are electromagnetic and "get better as they get bigger and faster." Therefore, he declares, with an attraction system "the Germans are fighting God."

But it is the control systems that bring out the venom in each concept's partisans. One attraction advocate declared: "there is no evidence that cryogenic systems will work. These people look too much at lab systems and are too far removed from actual vehicles." But the cryogenic advocates counter that there is no evidence that attraction control systems will be able to handle the high frequency oscillations induced at high speed.

For low speeds, the high magnetic drag of the repulsion system means that only the attraction system is viable. But it is not clear that any slow magnetic system will be superior to rubber tyres. Jayawant argues that without wheels his system would be much more reliable and easier to maintain, and that switching is simple because one of the guidance magnets simply follows a curved track. But magnetic vehicles are restricted in weight—Jayawant's vehicle (see Table 1) can only carry people because he plans to use lightweight materials such as fibreglass. "A railway carriage is built like a tank, but I'm not in that game", he said. Yet safety requirements might demand much more tank-like construction, leaving no weight for passengers. And linear motors mean a more expensive track, because of the copper reaction rail; a rubber-tyred vehicle could use a simpler, less expensive traditional electric motor.

Some of these questions will be answered by the next few years of research. The attractionists are now operating three machines: KM has an 11-tonne vehicle that has reached 164 km/h and is expected to reach 350 km/h this year. MBB has a six tonne unit which has reached 90 km/h, although components such as power collectors and gap sensors have been tested at 200 km/h on a rocket sled. By 1975 both firms expect to test high speed vehicles on the government test track now under construction near Augsburg. In Britain, Jayawant expects by the end of the year to have a one ton vehicle running down a 35m test track in a corridor in a Sussex University building.

The superconducting exponents are farther behind. The Japanese tested a 3-tonne, three-man car at 50 km/h in October, while Stanford tested a 300 kg unpowered unit at 36 km/h and 13.5 cm above the track in November. Rhodes hopes to have a two passenger test vehicle operating at 140 km/h at Warwick within two years, and within a year Siemens hopes to begin testing its own superconducting vehicle in Germany.

The technology is already available to build a magnetically suspended personal rapid transit system, and within a few years should be available for a high speed system. The difficult questions then are likely to be political and economic, not technical.

Technology review

Chile leaps into cybernetic future

The dream of operations research—to monitor an entire country's economy by a real time computer system—is actually happening in Chile. Data on one-quarter of the economy is fed daily into central computers, where it is analysed for significant deviations from normal and reports made to managers and government officials.

The system is an unprecedented use of cybernetics, and if successful probably will give the Allende government more control over industry than any government has ever had. Introduced in almost complete secrecy, the system is just now being revealed to managers and workers, and is sure to be an issue in the 4 March congressional elections.

One of Britain's most highly respected and controversial cyberneticists, Stafford Beer, developed the system in only 16 months. He described it publicly for the first time yesterday (Wednesday), in a lecture, "Fanfare for Effective Freedom", at Brighton Polytechnic.

Compared to traditional management information systems, Beer's system is surprisingly simple. Total input is probably less than 5000 numbers per day. The system uses only two medium size computers—an IBM 360/50 and a Burroughs 3500 at Chile's national computer centre. And it required relatively few people to develop—less than 100 scientists are working on the project for example.

But the system is pervasive and powerful. Special microwave and Telex links connect factories directly to the computer centre. The power is best illustrated by the October 1972 "bosses strike", when owners of transport com-

panies nearly brought the country to a halt by withdrawing services. It has been reported that using data coming in on the special communications system, Chilean leaders had an accurate and instantaneous picture of the state of the country. Computer models were reportedly used as an aid to selecting the best strategy to break the strike. As Beer commented, "communication is indeed control".

Instantaneous communication is the key. Beer argues that economic and industrial statistics are always so far out of date that action lags fatally behind problems. Firms that are going bankrupt do not even realise it, for example. Government statistics are at least six months old, which means that government action often comes a year or more too late. Because "economic movements operate in cycles", this means that out-of-date information often leads to precisely the wrong action.

The answer, according to Beer, is a "real-time nervous system of the economy". To do this, he uses not the traditional management information systems, but rather cybernetics and what he sees as invariant laws of all complex systems, including the human body, a company, or an entire economy. Last year, Beer outlined his "model of any viable system" in his book *Brain of the Firm* (Allan Lane, the Penguin Press), and this model has been applied in Chile.

"Interdisciplinary operational research teams set out to make crude but effective models of all major (nationalised) enterprises," Beer explained yesterday. These models are based on simplified flow charts of production, with boxes for



Flores

Beer

processes and lines for flow. Such pictures can be made at any level—if an entire industry is being modelled, a box might represent a whole firm, but if the firm was being modelled a box would be a production line or machine. Thus there is a hierarchy of flow charts because a box in one flow chart is itself often a flow chart.

For each flow chart, several critical points are selected to be monitored—these are usually input, output, employee absenteeism, bottlenecks, and particularly significant processes. A computer model is built based on the flow chart and using these numbers. In Chile there are four levels of models—individual enterprises, sectors (such as textiles), four branches (heavy, light, consumer, and materials) and the entire economy.

Typically, a firm has only ten critical numbers which must be telexed to the central computer each day. Beer has said that he could model any economy with input from 500 selected firms, so it is expected that the entire input in Chile is less than 5000 numbers per day.

Each number must be tested each day for deviations from normal. This is a complex problem because of natural variation, so each of the indices had its own model constructed based on 100 days of data.

Each day, the central computer uses Bayesian statistics to do a forward projection and calculates the probability that each of the input numbers is not merely a random fluctuation but stands for a change in slope or a step function. The program, called *Cyberstride*, "is incredibly sensitive to these changes, recognising them long before the human brain would dare to make a judgement", Beer said. The computer selects out those projections which seem significant and reports them automatically to the plant manager. Because the computer decides what is important, the manager is not overwhelmed with information, typically getting only one report per week.

Using the daily input, the computer also calculates the numbers needed for the higher level models, does similar projections, and selects out only the important changes. To reduce information to manageable amounts, the computer never gives a branch or sector manager more than 7 numbers a day, on average.

In order to preserve the manager's autonomy, an exception report goes only to him. But it can be seen higher up in the system in two ways. First, a signi-

Britain's last minute dash into Spacelab

Britain has decided to make a contribution to the European Space Research Organisation's Spacelab project (New Scientist, 18 January, p 129). The announcement, made on Friday (9 February) in the House of Commons by Michael Heseltine, Minister for Aerospace and Shipping, came at the last minute. Friday was the final day for ESRO members to make known their interest in participating in the Spacelab project. By joining the project before the deadline, Britain can now expect its aerospace industry to get some of the work on Spacelab.

Heseltine told the House that: "The next stage in the post-Apollo programme is the phase B2 study into the sortie lab and I have offered the European Space Research Organisation a contribution of £300 000 to this

stage. In doing so I have made it clear that the UK is in no way committed to participate in further stages of the studies or in the subsequent development and construction phases."

During the \$3 million phase B studies, which are due to finish by August, ESRO will find out just how much Europe can expect to pay for Spacelab development. If it looks like being too expensive—estimates put the cost between \$250 and \$275 million—then Europe has the option of pulling out and leaving the United States to do the job alone.

Spacelab is an important part of the post-Apollo scientific programme. It is an orbital space laboratory in which scientists will be able to carry out all manner of experiments. Last month ESRO held a conference of scientists to help define their scientific requirements so that the Spacelab designers could meet as many of them as possible.

ficant event, such as a strike or serious breakdown, will immediately affect higher models, although exact details of the difficulty are likely to be filtered out.

More important, however, the system limits the autonomy it gives a manager. If he had total autonomy he might not respond to the exception report, so the computer automatically gives him a time limit with each report. If the problem is not corrected in time, the report is passed up to the next level. Again there is a time limit, so that even a minor problem left unsolved long enough gets up to the top minister, Flores.

The system is not used just for daily monitoring of the economy, however. Standard long-term forecasting and simulation programs are being written in the Dynamo language made famous by its use for the Limits to Growth model. Top government officials, or a sector committee, can look at the probable effects of various courses of action, such as investment plans or redistributions of critical materials.

The heart of the entire system is the "operations room" in Santiago, which Beer proudly declares "looks like a set for a futuristic film". Paper is banned in the room, says Beer, and all information is displayed on screens and animated electronic displays that surround the room.

Beer began work on the system in November 1971. By March 1972 data was already flowing to the central computer. Cyberstride was in use by November 1972. The system works, according to Beer, and is beginning to be used. Five steps remain.

Naturally, considerable debugging and model correction must be done. Second, Beer hopes to expand the system to the entire economy by the end of Allende's presidential term in 1976.

Third, because the system was imposed from the top in relative secrecy, there is little understanding of it at lower levels. So the government must get managements to use the exception reports and to add their own indices to the system. Fourth, they will have to face an entrenched and probably angry bureaucracy which has been bypassed by the system. Finally, Beer is now working on a feedback system for the peasants and workers, so far ignored by the system.

Beer is conscious of the power that the system gives, and is aware that it could be misused—"like guns, we are surrounded by things that can be perverted". But he believes that the system involves less threat of authoritarianism than phases 2 and 3 of Heath's anti-inflation measures in the UK.

"The worst abuses of freedom come from an absence of tools. We have the technology to preserve freedom within a framework and the question is: Do you provide the tools or not? I must work within the instrumentality of the present."

"Humanity is in the grip of very powerful forces that will tear it apart, and we must build control instruments," concludes Beer. "Cybernetics can do the job better than bureaucracy."

Joseph Hanlon



The TXE4 telephone exchange is being tried out in the New Southgate headquarters of Standard Telephone and Cables Ltd. In 1971 the Post Office ordered 16 exchanges based on TXE4 at a cost of £16 million.

PO compromises on new exchanges

The long and bitter argument over which telephone exchange system the British Post Office will adopt for the immediate future has ended in an anti-climax. Neither of the rival exchanges has won a conclusive victory. Until 1980, at least, the Post Office will be installing both crossbar and TXE4 exchanges. According to the Post Office, the telephone improvement programme between now and 1980 "envisages purchases to the value of £350 million for crossbar and an increasing volume of TXE4 in its progressive development reaching £100 million.

Both TXE4, the choice of Standard Telephones and Cables for the next generation, and crossbar, which was favoured by Plessey and GEC, are no more than intermediate developments. TXE4 relies on reed relay switches to complete call connections, while crossbar still relies on electromechanical relays which are open to the air, with all the servicing problems that go with this. The computerised stored program controlled (spc) exchange that will ultimately dominate the world's telephone systems will have semiconductor electronic switches and computerised control (see "Tomorrow's telephones: the technical debate", by Michael Kenward, New Scientist, vol 53, p 468).

Much of the discussion on TXE4 and crossbar rested on the potential of these exchanges in export markets and in their ability to sustain further technical improvement. Despite claims that TXE4 is a dead end it now turns

out that it should be possible to go ahead with development of TXE7, which will incorporate some of the features found in spc exchanges. STC has, all along, said that TXE4 can, if the PO desires, be linked with some sort of computer control system. This will make it much easier to match TXE4 with both crossbar and spc exchanges, when these come into service.

During the discussions and arguments on the PO's choice of exchange the attitudes of the participants have changed. Both GEC and Plessey now accept that TXE4 is not such a dead end. In fact the idea that future telephone exchanges will be modular in their construction, could lead to an evolutionary spc exchange built around TXE7. This exchange would have separate control and switching systems. At first the "computerised" control would be wired logic, eventually giving way to more advanced memory systems. And the switching network could be changed so that the reed relay gave way to the solid state switch.

The TXE4/crossbar debate has been fought at such a pitch that the Post Office may now have some difficulty bringing the telephone equipment manufacturers back together to talk about "Project X"—the somewhat dramatic title that has been attached to the programme to develop spc exchanges. However, all three major manufacturers have developed extensive knowledge on spc systems and they must come together at a very early stage if the Post Office is not to be faced with yet another pitched battle when it has to decide on which spc exchange to adopt.

Don't count your chickens till they're dead

The factory complexes that turn live and kicking fowls into neatly trussed, plastic wrapped packages for the housewife to pop into her oven have long had a problem with numbers. An average establishment takes in up to 20 000 chickens a day, but has no way of checking the number of chickens delivered from farms against the number of trussed packages that emerge at the end of the production line.

Counting live chickens is no easy task, because, even when the hapless birds are hanging upside down from a conveyor belt, they kick and swing far too fast for an observer to keep track. In the abattoir, the chickens are stunned before their throats are cut. Only when they have passed through a "blood tunnel", in which most of the blood is drained off to stop the meat

going black, are they sufficiently motionless to be counted. Unfortunately ordinary mechanical counting devices are of no use, because the birds are not all the same shape—some may turn the counting device twice, while others may miss it altogether.

Having studied the problem for some months, Sheldon Controls Ltd, Wells, Somerset, decided that the best way to count dying chickens was by



ICL has more to worry about than government

The jousting session between sub-committee A and ICL last week was a sad mismatch of talents. ICL is very busy sorting out its "market selective" approach and clearly had given little thought to many of the bees buzzing in the bonnet of the Select Committee on Science and Technology's sub-committee.

For instance, the members of sub-committee A are obsessed with abolishing the system of single tendering by which ICL gets orders without competition. The original report produced an elaborate alternative to single tendering which still created the opportunity for public sector computer orders to be biased in favour of UK controlled suppliers. Last Wednesday the sub-committee was itching to listen to ICL's suggestions on long term equivalents to the "buy American" rule. ICL managing director Geoffrey Cross unconsciously registered his own set of priorities on this topic by answering "I haven't given any thought to it", when asked if he had any suggested alternatives to single tender.

Cross's view is perfectly reasonable from an executive hard at work on turn-

ing ICL into a broad based supplier of Western European computer applications in selective markets. But the phrase that slipped out sounded remarkably like gross contempt for the work of sub-committee A. It also revealed a lack of interest in the rest of the UK's computer industry; a fact which did not go unnoticed by some sub-committee members.

Similarly, after having clearly shown a preference for selective marketing through software specialisation, the ICL team muffed answering the next probe. Predictably, the group wanted to hear about ICL's plans for collaborating with independent software houses in Europe to fill in markets where ICL would not make direct offerings. But until ICL has all its detailed plans ready it can hardly be in a position to talk sense to the independent manufacturers.

ICL submitted to the sub-committee a 56 paragraph memorandum which shows a company in the centre of a whirlpool of transition. The core phrase is surely: "The acquisition and use of exceptional expertise in selected application areas is seen as a major weapon for securing new customers." Until the full momentum of such a thrust is felt in ICL's existing markets, it seems absurd to attempt to elicit concrete plans from ICL on many aspects of commercial alliances. The line that every avenue is being explored purrs from the ICL top brass, and what else does anyone in their senses expect?

It is muscle in the marketplace that counts in negotiations, and ICL can only negotiate on past history, looking at the weaknesses of other companies rather than its own strengths. This will change only when product development manager Ed Mack actually produces services that generate customer acceptance.

Cross made the point last week that for every £1 spent on R & D, ICL needed to spend £2.50 on marketing and supporting functions. The underlying theme of the "new" ICL voice seems to be that making effective use of that £2.50 sector of the budget was the immediate con-

cern of his office. He insisted that ICL intended that its staff at all levels should be heard and answered. He claimed that the fragmentation of the "old" ICL had been largely ended by the new organisational structures. With so much on the boil at Putney it seems silly for Westminster to want a ready-made Common Market aperitif from the ICL chefs.

After 12 months of tests, Sheldon Controls believes its technique is foolproof and hopes to sell the counting equipment to abattoirs internationally. At least the chickens can take comfort that their ends are numbered.

WATER ON THE BRAIN?

It's a common complaint among company directors. Here are some symptoms and remedies.

Pollution. problems, legal or otherwise, can often be solved by an Epsa system.

Pipe-scale. reduces the efficiency and life of heating systems and boilers; it is eliminated by the use of an Epsa recirculating system.

Corrosion. of treated metal pipes and tanks (this is avoided in deionised water).

Waste. of purified water in factories is avoided by using an Epsa recirculating system.

Poisoning. of drinking water caused by acid in water is cured cheaply by reverse osmosis.

There is an Epsa solution to most water problems. Best consult the experts.

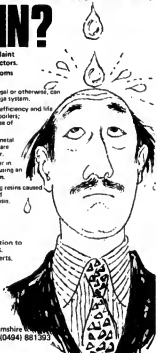


The Epsa Group
Lane End Buckinghamshire
Tel: High Wycombe (0494) 881352
Telex: 835116

I would like to know more about Epsa purification systems

NAME _____
POSITION _____
COMPANY _____
ADDRESS _____

Hidden nails and screws can wreak havoc with the cutting edges of chisels and planes. Edmond Theobald and Leslie Corke of Surrey (in BP 1 296 362) detect nails with a small bar magnet, pivoted inside a plastics case with a transparent window. The bar magnet carries a pointer line and the gadget is moved over a suspicious surface. When the magnet passes over a hidden piece of metal it dips. The device can also be used to detect the joints above plaster ceilings by the line of nails holding up the ceiling lathes. But hard-up do-it-yourself fanatics will probably do as well with an ordinary compass.



It takes a machine to catch a crook

Two new ways to catch a crook have been added to forensic scientists' armoury in recent weeks. One allows police to check whether glass on a suspects' clothing is from a particular broken window; the other automates tissue analysis.

Normally, traces of broken glass caught in the fibres of a suspect's clothes are not sufficient proof that he broke the window in question, even if the two types of glass appear exactly the same. The suspect can claim, without fear of contradiction, that there are probably millions of windows made from the same type of glass.

With the aid of a desk-top computer, however, forensic scientists can now make an accurate estimate as to whether two glass samples belong to the same window. The Home Office central research establishment at Aldermaston, Berks, has made a random survey of glass samples from some 1000 fires in shops in the UK. The samples cover only shop window glass (so the house burglar can still feel relatively safe) and have been classified according to refractive index and density.

The forensic scientist investigating a smash and grab raid will take enough of the broken window glass to make measurements of refractive index and density of at least 10 samples. A mean value of the refractive index can be calculated and compared with the refractive

index of particles from the suspect's clothing. If there is a close enough match between the two batches of samples, the Hewlett-Packard computer uses the data from the Home Office survey to determine the probability of the glass coming from some source other than the shop window. If necessary, more exact identification can be made later by chemical analysis.

Detecting poisons in liver tissues, on the other hand, has been possible for a long time. But the forensic scientist has had to do each stage of separating different groups of poisons by hand. Now International Research and Development Co. Ltd, Newcastle-upon-Tyne, has automated the process.

Its machine soaks and softens liver tissue, and mixes it with an equal quantity of water. The machine adds a chemical agent, such as a mixture of sodium tungstate and sodium bisulphate, to precipitate the protein which forms small granules when the container is heated. The granules are filtered off before the liquid passes to a series of vessels in which the five major groups of poisons—strong acid, weak acid, neutral, alkaloid and morphine fractions—are extracted by a progression of chemical reactions. The chemicals that cause each reaction are added through valves controlled by solenoids, and liquid passes between vessels either under air pressure or under vacuum suction. When the five major groups of poisons have been isolated, the forensic scientist is on

his own again—finer analysis has to be done by hand. IRD has already delivered one machine to the Home Office and expects to sell more to forensic laboratories abroad, especially in the US and Germany.

Standard pumps can swing big ships

When ships want to turn inside a harbour, they use a small propeller, separate from the large propeller which drives the ship forward. This small propeller lies between two halves of a tube stretching the width of the ship, and forces water out of one tube into the other, giving enough thrust to move the ship sideways.

Unfortunately, this method of turning has very slow responses. If the ship turns too quickly towards another vessel or a jetty, or if a small craft gets in the way, the captain can do very little about it because the thrust cannot be cut off immediately. Even if it could, inertia would keep the ship turning. Jamming the propeller into reverse, to produce an equal thrust in the opposite direction, might have even worse consequences, not least wrecking the propeller.

Why anybody had to use a propeller for this operation in the first place seems never to have been questioned. Certainly other methods of creating sideways thrust should be equally effective, if not more so. At least, so the British Hydro-mechanics Association, Cranfield, Bedford, believed when it set about designing a completely new turning system. BHRA's system retains the tube across the ship, but uses a standard marine pump in place of the propeller. The direction of the water flow and hence of thrust depends on the position of two small valves—water only flows through one half of the tube at a time. Water to supply the pump comes from below the ship (where extraction will have no effect on manoeuvres).

According to the National Research Development Corporation, which is trying to find a licensee (most likely a marine pump manufacturer) for the invention, the BHRA system should be considerably cheaper than propeller systems. A prototype unit at BHRA delivers a thrust of 2.5 kN; production units would have thrusts from 10 kN upwards. Standard marine pumps would be adequate to turn most vessels that dock regularly (super-tankers, which dock infrequently, are not fitted with turning units anyway) and probably the whole range of ships now fitted with propeller driven turning.

The design of the BHRA system makes quick course adjustments easy when the vessel is travelling at low speeds, and the additional thrust and high exit speed of water from the tubes make the system effective at higher speeds than with a propeller system. NRDC expects the system to be particularly useful in dredgers, ferries, and survey vessels, where manoeuvrability at low speeds is very important. If a pump manufacturer hites the carrot offered, NRDC will probably arrange tests of the system on a model vessel.

A cannibalised gun provides a mount for a pulsed-laser ranging system.

The Institute of Applied Geodesy recently opened a satellite observation post in Bavaria, West Germany. The laser equipment measures satellite orbits to an accuracy of a centimetre. The distance between the ground station and a satellite can be determined by measuring how long it takes a light pulse from the laser to travel to the satellite and return to the ground station. The scientists operating the laser ground station hope that by taking measurements over a period of years they will be able to detect changes in the Earth's gravitational field and continental drift.



We've looked into a lot of problems in the past 10 years

... a decade of service to industries of all sizes and to government departments.
At IRD we have a strong team of qualified scientists and engineers, a total staff
of some 350 and a wealth of technical experience. Just look at some of
the things we have been involved with and see how our experience can help you.

- 1 A sharper edge to razor blades
- 2 Monitoring pollution for smelting plant
- 3 Heat pipes for a communications satellite
- 4 Alignment and survey lasers
- 5 The world's first superconducting motor
- 6 Chemical vapour deposition of extremely hard wear-resistant coatings
- 7 Cadmium sulphide solar cells
- 8 Test rig to check the performance of air filters
- 9 High pressure rigs for creep tests in gas at 500°C
- 10 A laser technique for vibration measurement
- 11 Rigs to demonstrate hydraulics in fire fighting systems
- 12 Flameproof lasers for use in coal mines
- 13 Equipment to calibrate infra-red detectors in satellites
- 14 Encapsulation of quartz halogen lamps for deep sea use
- 15 Compatibility study of thermal insulation materials
- 16 High vacuum equipment for testing ion engine components
- 17 Purifying plant for swimming pools
- 18 Gamma ray detectors for balloon-borne investigations of galactic radiation
- 19 Equipment to study plasma physics phenomena
- 20 A high-discrimination strain transducer
- 21 Flash tubes for cosmic ray studies in India, South Africa and USA
- 22 A metallic brush to remove spilled mercury from aircraft
- 23 Compact light-weight titanium heat exchangers for marine use
- 24 Prevention of marine fouling by electro-chlorination
- 25 Laser ophthalmoscopes
- 26 Rig for testing high pressure hoses
- 27 A method for plating carbon fibres
- 28 High vacuum reflectometers for testing satellite mirrors
- 29 Theory of crack propagation

- 30 An infra-red detector for fire and intruder warning systems
- 31 Laser and electro-optic crystals
- 32 Metallurgical investigations of materials for supersonic aircraft
- 33 Strain measurements on road and rail bridges
- 34 Lasers for microwelding and drilling
- 35 Ceramic coating techniques to improve the wear characteristics of machine parts
- 36 Explosive techniques for joining pipelines
- 37 Holographic studies of air-blast circuit-breakers
- 38 An infra-red detector for satellite orientation
- 39 Automatic separator of toxins for forensic analysis
- 40 High field solenoids up to 180 kGauss
- 41 Rig design for tensile tests on ropes
- 42 A powered chair for handicapped children
- 43 3250 hp superconducting motor
- 44 Prototype displacement measuring systems
- 45 High temperature furnaces for corrosion studies
- 46 Research on dry bearing materials
- 47 Survey of dynamic power sources for underwater application
- 48 Superconducting marine propulsion systems
- 49 A liquid hydrogen storage vessel
- 50 Repair of heat exchangers by explosive techniques

**You can look at the next ten
over our shoulders in the
IRD Newsletter**



To International Research &
Development Co Ltd Fossway
Newcastle upon Tyne NE6 2YD



Please put me on your mailing list ☐
Send me back numbers of IRD Newsletter ☐

name
position
company
address

Tomorrow's broiler sheep stay fit on barley

With lamb prices sure to follow the rise of beef prices, farmers will find it worthwhile, for the first time, to invest large sums in lamb production. High-input high-output systems, similar to those already well established for beef and pigs, will be applied to lambs.

There will be three obvious changes: sheep will be reared increasingly indoors; ewes will be expected to produce three or more lambs at a time, and preferably two litters a year; and lambs will be fed on high energy diets, to get as much growth from them as possible.

A high energy diet means, in practice, one based on barley. So—were it not for recent discoveries at the Rowett Research Institute at Aberdeen—lambs might soon have suffered the same digestive disorders that beset cattle, when farmers first started feeding them on barley some 10 years ago. But Dr Bob Orskov has found that lambs can remain perfectly healthy on barley and, incidentally, has shown how farmers can reduce the cost of the cereal diet.

The basic difficulty is that ruminants—of which cattle and sheep are the prime farming examples—have evolved a digestive system that deals admirably, but preferably, with low-energy high-roughage diets, the principal component of which would generally be grass. Ruminants' outstanding feature is a huge globular stomach, the rumen, within which a complex compost heap of bac-



teria ferment coarse grass blades into organic acids. The ruminant digests and absorbs these acids and uses them as a source of energy. But this system can be thrown off balance when the energy content of a diet is stepped up: production of acids can then become so great that the rumen wall is inflamed and deformed, and the gas output can be high enough to cause the animal to become literally bloated.

This has happened to barley-fed cattle, particularly when the barley is too finely ground, and its surface area, and therefore its rate of fermentation, increased. Further, as Rowett's Dr Bernard Fell and his colleagues describe in *Research in Veterinary Science* (vol 13, p 30), the deformed gut wall traps hairs, which the affected cattle lick from themselves and their companions in their craving for roughage. These hairs penetrate the rumen wall, allowing bacteria to pass through; and these, in turn, may cause liver abscesses.

Barley beef producers have to some extent got round these problems by giving their animals some roughage, and by not macerating the barley so finely. Bob Orskov, working with the fore-runners of tomorrow's commercial

barley-fed sheep, took this thinking to its logical conclusion. As he describes in *Proceedings of the Nutrition Society* (vol 31, p 101A) he fed his charges whole barley, straight from the bag. These animals grew as quickly as those fed more conventional pelleted grain, as fed to cattle and pigs. Their rumen contents remained far less acid, and their rumen walls were not deformed. In addition, the quality of their carcasses was improved as their fat was harder and firmer than that of lambs fed pelleted barley. It seems, therefore, that as far as feeding goes, sheep could move painlessly into the high-production era: not only can they easily be fed on barley, they may take more easily to the cereal than any other farm animal.

A compact, portable wind generator originally designed to "top up" boat batteries is now finding use in under-developed areas. *Aerocharge* is much smaller than the windmills described last month in *New Scientist* (4 January, p 24), producing only 3W in a 15 to 30 km/h wind.

The unit costs £28 and uses a 14-bladed 43 cm diameter plastic fan. It was initially designed for trickle charging a boat's battery while the boat is moored, to compensate for current leakage. About 500 have been sold by Harbus Ventus Ltd, Poole, for this purpose, including one to the French Naval Attache in Moscow for his yacht in the Caspian Sea.

But in the year that the device has been on the market, about 100 have been sold for non-boat uses. One has gone to the Zambia Flying Doctor Service to charge batteries and another to Imperial Oil Ltd, Calgary, Canada, for a radio transmitter inside the Arctic Circle.

No easy way to clean grimy buildings

In spite of all the newly cleaned masonry on many old buildings in London and other major cities, no one has yet developed a cleaning method that is both efficient and harmless. A recent review of current methods by the Building Research Establishment, Garston, shows that simple washing with water—one of the most common methods—can cause trouble inside the buildings, soaking plaster for example, and produces "brown patchy stains" on limestone. Blasting with dry grit, another popular method, can damage the masonry, as well as nearby windows. Both these methods can be a nuisance to passers-by. Wetting the grit helps a little, but increases the risk of blocking drains and can stain limestone. Although grit blasting is fast it is also expensive.

Chemical cleaning is even more hazardous. Most cleaning agents contain soluble salts, which will eventually damage the stonework. The only two chemicals which seem to be both efficient cleaners and harmless to the stonework are hydrofluoric acid and caustic soda, both of which can do the job quickly and relatively cheaply. Unfortunately, both materials are dangerous to handle, and splashes could badly injure passers-by.

Flygt pump sewage out of sight!



Below ground, out of sight, Flygt Sewage Pumping Stations work automatically without supervision. The aesthetic advantages are obvious and the economic benefits equally real.

Interested Engineers and Technologists are invited to write for technical data on underground sewage pumping stations to:-

ITT Flygt Pumps Limited

Colwick, Nottingham.
Telephone (0602) 241321
Telex 37316



Black Panthers in and on science

Dr Curtis Powell, a biochemist, and Clark Squire, a systems analyst, spent 25 months in jail awaiting acquittal on bombing and conspiracy charges. Ann Rosenberg talked to them about how they became scientists and Panthers, and how they relate the two



Dr Curtis Powell chats to a friend at the victory party after his acquittal

When Black Panther Clark Squire was first arrested in 1969, he was so concerned that his absence would impede work on a computer system that, in his cell, he documented all of his work on the system. His documentation was good enough to let other people pick up where he had left off.

Values change slowly and inconsistently. When he was first arrested, Squire had been in the Panther party only three months. He was still concerned about his computer work, although he was already "becoming schizoid about maintaining two sets of friends, two vocabularies, and two methods of dressing—one at work and the other away from work." Now he has completely abandoned computing to become a full time organiser for the Black Panthers.

Before their arrest for bombing and conspiracy, both Squire and Dr Curtis Powell

were the success stories of the sort that makes America so proud. Both mothers were domestic help for white people and both men rose through their own perseverance. Squire grew up in a small Texas town. Despite predictions that he would never finish, he graduated high school two years early at 15. Squire's tiny community raised the money to send him to the local Prairie View Agricultural and Mechanical College. "I wanted to be a doctor, but medical school would have been too expensive. So I took a course in maths because it seemed like some kind of alternative."

When he finished college, he found there were no jobs for a 19-year-old inexperienced unsophisticated black man with a Texas accent. After six months and many applications, he finally acquired a job with the engineering department of NASA. When a computer section was set up, Squire was part of the staff. In the rapidly growing and highly mobile computer business, he moved easily to other aerospace and military firms, finally joining a New York City consulting company in 1964. When arrested in 1969, he was earning £7500 per year and had a good reputation, particularly for computer systems in the garment industry. Ironically, the consulting firm he worked for was then best known for developing computer systems for the police.

Powell grew up in a suburb of New York City and went to a good, 90 per cent white, school. In eighth grade (age 14), the three top scorers in a special intelligence test were supposed to go to the University of Chicago in a special programme that combined high school and a university. Powell got the highest score but school officials decided that he was not emotionally ready to leave home. Two boys from the school were sent—both white. Powell's reaction was to quit school for a year, then return to make up two years in one. He went on to college, but finding it impossible to gain the education he wanted in the US, he went to the University of Stockholm for his PhD. He moved into traditional research, and when he was arrested was earning £6000 per year as a cancer researcher at Columbia Presbyterian Medical Center in New York.

Both men joined the Panthers in November 1968. By the time of their arrest on bombing conspiracy charges in April 1969, Powell was Captain for Security and Squire was Lieutenant for Finance. Both were active in attempts to win community control of schools and hospitals and in the Panther's free breakfast for children programme.

But both were still active and successful in the white world, too. "But I began to realise that by staying in the system and looking successful, I was misleading a lot of other black people. I was not free but I possessed many of the symbols and appearance of

freedom. I felt I was leading brothers to mistake for freedom the Brooks Brothers suits, attaché cases, American Express credit cards, first class flights, and sports cars—and that was a lie. All I had done was survive when too many of my brothers hadn't survived—smashed, broken and castrated by racism and exploitation. When I was in jail I began to understand that as a people we have been in jail all our lives anyway."

The split between two different lives was becoming clear to Powell as well. "Before I went to jail I still had a tendency to think of what I was doing as 'part of my career'. But a biochemist is not working specifically to help people or cure cancer. He's in there because some aspect of a cell interests him, like a crossword puzzle. He sees he can get more money to do this research from a cancer foundation so he will link up how it can be used for cancer. But that is not primarily why he's in there." By the time he was arrested, his work was "just a job to feed my family."

The two years in jail gave both men a chance to rethink their roles—an appraisal accentuated by their isolation both from other black radicals and from the literature necessary to keep up in their fields. After their release 18 months ago, neither returned to his previous work. Squire dropped out of computing entirely to become a full-time community organiser. Powell shifted to public health work, remaining active in the party.

Serving the community

Both were giving up a hard earned skill that could command a high salary, but they chose different levels of political involvement. They have moved from a previous desire for personal success to work they believe will help humanity, and they see an important place for science and technology. Powell argued that "science and technology can benefit people, but they are not oriented that way now. Scientists and technologists are very

well equipped to work on the real needs of the people—when they are accountable to the people.

"It's a question of what the community needs. If a person knows that he can make a contribution through maths and can see that there is a need, then Right On." The problem, then, is to balance any work on relevant science and technology with the need to work directly in the community on non-technical projects.

"After I left jail, it wouldn't have been difficult to get a job if I had been willing to sacrifice my life. There were people who wanted to hire me on the basis that I divorce myself from everything else. I am now working as a scientist in public health, not within the corporation. It's a small contribution, not as much as could be made if public health was in the hands of the people," Powell admitted. But he has returned to science with a new attitude that the work no longer takes priority: "If something were to come up dealing with the revolution or serving the people, there would be no hesitation: I wouldn't go to the lab."

The ability to make this choice is important in the decision to return to science. "Doc has the ability to stay in his field and juggle his hours. Computers are more restricting—you have to put in long hours. Doc can be a biochemist and a revolutionary at the same time; I don't think I can," Squire noted.

Another factor supporting their respective choices is the relative number of blacks in each field. "The last figure I saw was 379 black people with PhDs in the medical sciences. There are many more blacks in the computer field because computers came into being during the so-called integration era," Powell said.

Both men argue strongly that there is a need for technical competence in the black community: "You must learn technology so you know how to destroy it when it is used against you, but then when there is a new

American justice

A jury took less than two hours to acquit 12 Black Panthers of all 167 charges against them. The trial had taken six months and cost the state of New York an estimated \$2 million. The Panthers spent 25 months in jail awaiting their acquittal.

In pre-dawn raids on 2 April, 1969, Clark Squire, Dr Curtis Powell, and 10 other Panthers were arrested by police who raided their homes without search warrants. Among the evidence taken from the homes and used at the trial were an alarm clock and a child's drawing of a clock face, said to be a bomb timer and a time bomb plan. Within hours of the arrests New York District Attorney Frank Hogan announced on television that the Panthers had planned to bomb five department stores filled with Easter shoppers that day, and also to bomb a botanical garden filled with 6000

tulips.

Bail on each of the Panthers was set at \$100 000, unusually high for people with no prior convictions and with roots in the community. Squire and one other Panther came up before a more liberal judge who halved the bail. A New York group, Computer People for Peace, then collected the money. But when they presented the bail and attempted to get Squire out, State Supreme Court Justice John M. Murtagh, who was hearing the case, simply cancelled Squire's bail.

Dr Powell's wife gave birth to a premature infant while Powell was in jail. The child died shortly after birth, but Powell was not permitted to speak to or visit his wife in the hospital. Throughout the trial, the prosecution refused to address Powell as "Doctor" despite presentation of documents attesting to the degree.

Prison conditions were particularly bad. Initially the Panthers were kept

in "24-hour lock-up", with lights on day and night. They had no access to books, television, or recreational facilities, and were not permitted to talk to other prisoners. Murtagh refused to consider their protests, and they spent nine months under those conditions before US District Court Judge Tyler overruled Murtagh and ordered the Panthers moved.

District Attorney Frank Hogan, prosecuting the case, was allowed to pick Murtagh as the Judge to try the case—an important choice because a judge must rule on admissibility of evidence, and Murtagh had a reputation for permitting anything presented by a policeman.

Despite the elaborate precautions and unusually lengthy trial, the jury was unable to believe the prosecution, and on 13 May, 1971, unanimously found the defendants innocent of all charges, after less than two hours of deliberation.

society you will have something that can be used for the benefit of all," Squire explained.

"As many of our people as possible should learn technology with the idea of countering the technology that the government is exploiting against us. At present technology is used to oppress the people—look at Vietnam with sensors and all that garbage. If we don't know about sensors, they're a little more difficult to get around. I'm sure the Viet Cong aren't studying electronics to get around sensors, but they do take them into consideration and they do know how to destroy them," Squire declared. "And there is a very distinct possibility that one day this country will use biological warfare on black people. Doc has an opportunity to stay abreast of those advances."

"But right now it isn't as important as later," Squire conceded. "We have full confidence that there will be a people's revolution and that afterwards the science and technology we know will be useful to the people."

"We can't limit ourselves to just one aspect of the revolution. At the end of a war there is always a drop in the standard of living of the people. It takes time to change things around and we must have people who have an ideological base towards serving the people in certain positions as soon as possible," Powell added.

Both Powell and Squire accept the argument that technology is neutral, and do not agree with those who would simply throw out computers. "Computers can be put to very good use. We have to be careful not to take the tools of the beast for the beast itself. A computer is a tool, that's all. Just like a gun. Is there a fascist gun, a racist gun?" Powell asked.

But they concede that not everyone accepts this analysis, and that unity and cooperation are necessary. "You have a group of people

with real needs, and on the other side you have all types of crazy reactionaries, liberals, and pseudo-radicals in the scientific and technological fields. If the people in these fields reach the stage where they say 'OK, we're going to turn this around and serve the people'. Fine, then we can consolidate the forces. If not, the people will most likely destroy science and computers," Powell warned.

What course for others?

Powell and Squire are both 35 and have long finished their training. Would they advise other blacks to get technical training now?

Squire: "We don't peddle going to school. That was one of the things we fought for 20 years ago. Now the blacks go to school, but what they learn is completely reactionary, counter-revolutionary, and counter-black-survival. They learn that if they get education and money they'll succeed."

Powell: "When you talk about sending a lot of people to schools, you have to talk about changing the schools so they don't teach a reactionary state of mind. But we should have more people who know something about medical research, physics, maths, and so on."

S: "Definitely there is a need for people to learn science and technology, but I'm not recommending that everyone goes whole hog into it. The basic problem is that people have to first deal with society."

P: "There will be people who will feel with their natural make-up that they will have to go to school first and then join the revolution, others will feel they have to join the revolution first. But you must always ask 'What is best for my people?' instead of 'What do I want to do?' Revolutionary commitment has to be second nature, like driving or like being a scientist."

Vitamin D changes its clothes

Ten years of brisk research has uncovered unsuspected sophistications in vitamin D metabolism; the vitamin appears to operate like a hormone

Dr Roger Lewin

"The Cinderella vitamin of the 1940s has turned into a hormone". This was how Dr Egon Kodicek described the "aesthetic" story of recent research on vitamin D at a Biochemical Society meeting held in London last week. Through his work at the Dunn Nutrition Laboratory in Cambridge, Kodicek has probably contributed more than anyone else to revealing the unsuspected true colours of this fat-soluble vitamin. Not only have the events of the past 10 years proved to be fascinating and rewarding scientifically, but the discoveries also turn out to have important implications both for medicine and agriculture, an outcome that could not possibly have been predicted by even the most foresighted prophet.

Vitamin D is involved in maintaining the

correct balance of calcium in the body, calcium being important both in manufacturing bones and in the normal functioning of nerves as well as in many enzyme reactions. The vitamin is not alone in controlling calcium metabolism; the two peptide hormones parathyroid hormone (PTH) and calcitonin work in concert with vitamin D in holding constant the blood level of calcium (Figure 1): calcitonin tends to reduce high concentrations of calcium in the blood while PTH and vitamin D do the opposite.

Research into vitamin D (Figure 2) was given considerable impetus in the 1940s by the concern about rickets, the disease in which insufficient calcium is laid down in developing bones. Vitamin D was found to cure the condition by increasing calcium absorption

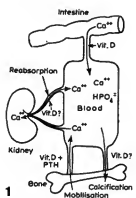


Figure 1 The involvement of vitamin D and parathyroid hormone in calcium metabolism

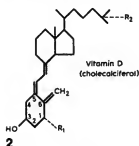


Figure 2 Chemical structure of vitamin D (R_1 and $R_2 = H$); 25 HCC ($R_1 = H$; $R_2 = OH$); and 1,25 DHCC ($R_1 = OH$; $R_2 = OH$)

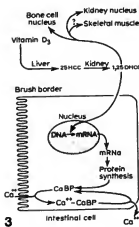


Figure 3 The metabolic role of vitamin D and its metabolites

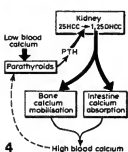


Figure 4 The action of parathyroid hormone (PTH) in stimulating 1,25 DHCC formation

from the intestine; the search to discover its mode of action was on. At first researchers were seduced into looking for a coenzyme role for vitamin D. After all, hadn't all the B vitamins turned out to work by combining with specific enzymes? But the big difference between the B vitamins and vitamin D is that the former are soluble in water but the latter is very definitely not. Another clue that suggested some role other than that of a coenzyme was the discovery that it took some 10 to 12 hours after administration before any effect on calcium absorption could be detected. The events of those dark 12 hours are now solved, but the solution didn't come easily.

In 1964 two Americans—Drs N. Passavoy and R. Eisenstein—came up with a discovery that was to be central to the whole vitamin D story, but at the time the true significance of the observation was not fully appreciated. They found that by blocking transcription of DNA to mRNA the action of vitamin D on calcium absorption could be inhibited. It seemed therefore that vitamin D might be involved in the initiation of protein synthesis.

The first really big breakthrough in the study of the biochemistry of vitamin D came in 1966. In that year both the Dunn Laboratory in Cambridge and the powerful Wisconsin team led by Professor Hector DeLuca obtained radioactively labelled vitamin D of high specific activity. Just by chance the two teams used different types of labelling, and, as it turned out, Kodicek's choice was extremely fortuitous; it gave him an important advantage in the competition with the Americans.

In 1968 it looked as if DeLuca had got the answer everyone was looking for. Using his vitamin D (labelled with tritium at C-1 and C-2) he discovered what he thought was the active form of the vitamin. After feeding his radioactive vitamin to experimental animals he found a labelled compound located in the nuclei of intestinal cells. Here surely was good evidence that the substance (which he later identified as 25-hydroxycholecalciferol (25 HCC); see Figure 2) was indeed the form of vitamin D that initiated protein synthesis. But, try as they might, Kodicek and his colleague Eric Lawson could not repeat DeLuca's crucial experiment. The reason, it emerged later, was that the Cambridge group's compound was labelled only at position C-1; this small difference proved to be vital.

When they tried DeLuca's experiments with their own labelled compound Kodicek and his colleagues could not detect any radioactivity in the nuclei of intestinal cells. After puzzling for a long time about where the label had gone, they switched to a vitamin D doubly labelled with tritium at C-1 and carbon-14 at C-4. All now became clear; when using this compound they did find radioactivity in the nucleus, but the label was almost exclusively C-14. Clearly before the derivative enters the nucleus its C-1 position is altered resulting in the loss of tritium. The Americans did not realise this happened because their compound was also labelled with tritium at C-2.

In May 1969 Kodicek went to Wisconsin to suggest that an oxygen function (OH) was probably added to 25 HCC at C-1. This prediction proved correct, and, with a dramatic sense of timing, both the Wisconsin and Cambridge teams announced final identification of the substance in the nucleus—1,25 dihydroxycholecalciferol (1,25 DHCC; see Figure 2)—within a couple of weeks of each other at the beginning of 1971.

Before 1,25 DHCC had been identified David Fraser in Kodicek's laboratory at Cambridge made the remarkable discovery that the only tissue in the body capable of converting 25 HCC to its more polar metabolite was the kidney. By this time it was clear that the metabolism of vitamin D was anything but straightforward: after being ingested in the diet it is first converted to 25 HCC in the liver (probably by hydroxylating enzymes in the microsomes); 25 HCC is further hydroxylated by mitochondrial enzymes in the kidney; the final product—1,25 DHCC—then goes to its target cells (see Figure 3).

The past couple of years has seen intense efforts on both sides of the Atlantic to determine what function 1,25 DHCC performs in the intestinal cell nuclei. Although there is still brisk argument, it seems probable that the compound initiates the transcription of mRNA leading to the synthesis of a specific calcium-binding protein (CaBP) which helps to transport calcium from the intestinal lumen, via the intestinal cells, and finally into the blood (see Figure 3). According to evidence recently published by the Cambridge and Wisconsin workers, the trigger to 1,25 DHCC production in the kidney might be parathyroid hormone (see Figure 4).

The Cambridge group suggests that vitamin D (or rather 1,25 DHCC) should be dressed in the clothes of a hormone for a number of reasons: chemically it is very reminiscent of the steroid hormones; the biochemical systems controlling 1,25 DHCC production are very similar to those for steroid hormones; it is active in finite small quantities (intestinal cell nuclei are saturated at 2800 molecules of the metabolite per nucleus, a figure of the same order as that for other steroid hormones); the location of 1,25 DHCC's activity in the nucleus, rather than other parts of the cell, is very hormone-like. This being so, the kidney can be thought of as an endocrine gland for the elaboration of the hormone 1,25 DHCC.

The current flood of new knowledge about the metabolism of vitamin D permits the questions that were being asked about the mode of action of the vitamin 10 years ago to be now posed much more accurately. Although there are still many gaps in the knowledge of vitamin D activity—particularly in bone—the elucidation of its curious metabolic pathway already promises to have significant practical impact.

In medicine a number of important conditions are thrown into an entirely new context now that the liver and kidneys are known to be involved in vitamin D biochemistry. In chronic renal failure, for instance, doctors have long been puzzled by the attendant

osteomalacia (loss of calcium from the bones) and failure to absorb calcium from the intestine. The reason now is obvious: kidney failure probably leads to decreased production of 1,25 DHCC. Now that many patients with renal dysfunction can be maintained on dialysis the problem of calcium imbalance could become more widespread. At the end of last year Anthony Norman—an ex-colleague of DeLuca—reported administering very small quantities of 1,25 DHCC ($2.7 \mu\text{g}$ per day) to renal failure patients. The effect was dramatic: calcium absorption shot up from the previously very low levels. Patients

at risk on renal dialysis may have to be maintained on daily doses of 1,25 DHCC, or possibly a suitable analogue.

The new vitamin D hormone may find applications in agriculture too. In bovine milk fever disease—a condition of considerable economic importance in this country—cows have very low blood calcium levels at the onset of milk production. Present methods for treating the condition are not very satisfactory, and it may be that small injections of 1,25 DHCC could restore calcium metabolism to normal much faster than other available techniques.

No halt in the nuclear arms race

The disarmament conference starting a new session in Geneva next week faces the problems of technology outpacing weapon controls and of the separate discussions carried on by the United States and Soviet Russia

Stephen Rowe

is a specialist in nuclear disarmament

The 26-nation Conference of the Committee on Disarmament (CCD) will reconvene in Geneva on 20 February to begin its 12th year of negotiations "with a view to reaching agreement on general and complete disarmament"—an objective that long ago became more of a hope than an expectation.

The conference struggles sluggishly on in spite of several major handicaps. The Soviet-American co-chairmanship has led to superpower domination—a monopoly greatly resented by the lesser powers. France has consistently refused to take its seat at the conference. China is not a member and shows no interest in becoming one. The major world forum for disarmament negotiations is likely to remain in a state of suspended animation until these handicaps are removed by a far-reaching reorganisation of its composition and modus operandi. In the meantime, continual advances in military technology fuel the arms race and the world-wide trade in arms is rapidly spreading the most sophisticated weapons to the most minor powers. It is hardly surprising that the morale of the CCD delegates is at an all-time low—a state of affairs not helped by the fact that the USA and USSR are separately holding bilateral and secret (but prestigious) negotiations on strategic nuclear arms limitations in the same city.

The most recent achievement of the CCD, and the only genuine disarmament measure it has so far negotiated, was the convention on the prohibition of the development, production and stockpiling of biological and toxin weapons and on their destruction. The convention, opened for signature on 10 April, 1972, will come into force only after ratification by 22 governments and after the agreement of the United Nations Security Council to receive, consider and act upon complaints of violations. Neither of these requirements has yet been met.

The biological convention commits the parties to negotiate an agreement to prohibit the possession of chemical weapons. Discussions on chemical disarmament are likely to dominate the proceedings in the CCD this

year but progress will almost certainly be slow. Many countries have chemical warfare agents; many more have the basic materials and the knowledge for their production. But a more serious barrier is that chemical warfare, unlike biological warfare, is considered to be militarily useful and has, in fact, recently been extensively used. Some military authorities will, therefore, strongly resist losing the chemical weapons in their arsenals. And history shows that the most difficult weapons to ban are those in which the military retain an interest.

The greatest controversy during the discussions will centre around which chemical materials should be classified as warfare agents. The most obvious criterion is the degree of toxicity of a given agent on man, animals or plants. But this is complicated by the development of so-called binary weapons which generate a supertoxic agent when two separate low-toxicity compounds are mixed, either just before the weapon is fired or when it is already in flight to the target. As always, the disarmament tortoise is overtaken by the technological hare.

Chemical weapons

The debate on chemical disarmament has not, in fact, yet passed the preliminary stage of an exchange of views. The type of agreement to be negotiated—whether it should, for example, be partial (including only lethal agents) or comprehensive—has not been concretely decided. And then there is the vexed issue of verification. Should this be achieved through national means of control or should it include on-site inspection? Experience shows that verification is likely to be the excuse for delaying the negotiations until the political will for chemical disarmament exists. The problem of verification will then be rapidly solved. In the meantime, the cause of chemical disarmament would be greatly served if the Geneva Protocol prohibiting the use of chemical weapons were adhered to by all states and particularly if the comprehensive character of the ban on use were universally accepted without reser-



vations.

The second major item on the agenda of the CCD will be a continuation of the already nine-year old debate on a comprehensive ban on nuclear-weapon testing. Many nations had expected that the Strategic Arms Limitation Agreements, signed by the USA and the USSR in Moscow last May, would put an end to nuclear weapon testing by the superpowers or, at least, that these agreements would soon be followed by an agreement on the cessation of tests. But this optimism was not justified and the tests go on—both underground, by the USA and the USSR, and in the atmosphere, by China and France—totally ignoring numerous UN resolutions condemning nuclear-weapon tests without exception and in the face of strong international objections to such tests; no disarmament problem has caused greater concern to the world community.

Since the Partial Test Ban Treaty in 1963, which includes a legal obligation on the nuclear-weapon parties (USA, USSR and UK) to formulate a complete ban, more tests have been conducted underground than were conducted in all environments prior to that date—the total number is about 1000. The question of verification has been the main excuse for the failure to negotiate a comprehensive agreement. The USSR considers national means of detection and identification of seismic events to be sufficient for verifying an agreement but has not explained how this would operate in practice. The USA insists on on-site inspection to investigate ambiguous events but has not explained how and when inspection would be put into effect.

Notwithstanding the inertia of the USA and USSR, other powers are making efforts to contribute to the solution of the verification problem. Canada, Japan and Sweden, for example, have agreed to improve cooperation in the detection, location and identification of underground nuclear explosions by seismological means. And the United Kingdom has described new data-processing equipment for monitoring such explosions. Most countries now recognise that a complete test ban can be verified by seismological means to an extent which would provide sufficient deterrence against clandestine explosions to be politically acceptable.

In practice, it is now possible to achieve a detection threshold of about 1 kiloton and an identification threshold of about 5 kilotons-10 kilotons for underground testing in hard rock. In theory, these levels are higher by an order of magnitude for testing an alluvium and higher still for testing in a large cavity (decoupling). But considering the technical realities, underground testing above about 10 kilotons-15 kilotons could be made very risky for a cheating tester by seismic monitoring alone. Satellite observation and other non-seismic methods would add to the risks of the clandestine tester.

It is now well understood that no verification can be fool-proof and that the principle of deterrence applies to possible violations of international agreements. The process of consultation, inquiry and "verification by chal-

lenge" is generally regarded as an effective and adequate means of verification in the field of disarmament and it is already established that arms control treaties should contain withdrawal and review clauses to safeguard the parties. For these reasons, it is reasonable to assume that the failure to achieve a comprehensive test ban is due less to the problem of verification than to political considerations. For example, the Soviet demand that all countries, including China and France, should cease testing simultaneously could cause an indefinite delay, if it is meant as a condition for cessation by the Soviet Union itself.

Be this as it may, an orderly discussion on the application of seismological verification to a comprehensive nuclear test-ban is long overdue. How will seismological data be collected, coordinated and exchanged between states? Will an international agency be established and empowered to evaluate the data contributed by states? Will arrangements be made for the use of nuclear explosions for peaceful purposes? If so, under what authority?

Seven Soviet explosions

The usefulness of peaceful nuclear explosions is controversial. Judging by the number of peaceful nuclear explosions actually made, American enthusiasm for them had diminished in recent years whereas Soviet enthusiasm has increased. Thus, during 1972 there were no nuclear explosions for peaceful purposes in the United States (in previous years there had been many each year) but in the Soviet Union there were at least seven (three in West Russia, one north of the Caspian Sea, one north-west of the Caspian Sea, one in West Kazakh and one north of the Black Sea). The Soviet explosions have been for oil reservoir stimulation experiments, for the excavation of large water storage reservoirs and to extinguish gas-well fires. The rising world population and the rapid depletion of the easily obtainable reserves of some resources may provide compelling reasons for developing a viable peaceful nuclear explosions technology. In particular, some underdeveloped countries, such as India, Brazil and Egypt are showing increasing interest in possible applications of nuclear explosions in development projects.

A comprehensive and universal ban on nuclear tests may be the most important immediate step which can be taken to halt the nuclear arms race. The cessation of underground tests by the USA and the USSR might improve the prospects the two nuclear powers which are not parties to the Partial Test Ban Treaty (France and China) might also stop all testing. Perhaps more importantly, the move would strengthen the Non-Proliferation Treaty; it might even prevent the emergence of a sixth nuclear weapon power.

When the progress made so far in the CCD is measured against the pace of the nuclear-arms race it is all too obvious that this race has not been halted, nor even has its dangerous momentum been controlled. Without the efforts of the CCD the present situation would be even worse. But this is cold comfort.

British professions and EEC rules

Proposals in Brussels to standardise qualifications throughout the Community could have serious effects on Britain's professional bodies and on the education system itself

Lord Bowden

is principal of the University of Manchester Institute of Science and Technology

Last year I went to a conference of university rectors in the great Technical University of Delft. We were discussing the profound differences which exist between the systems of engineering education in different parts of Europe. In England, a man graduates at the age of about 21 after taking an intensive three-year course which is often followed by a couple of years' postgraduate apprenticeship. A Dutchman graduates after seven or eight years at the age of about 26 or 27. Germans take a course which lasts at least five years and may take twice as long.

We were interrupted by a gentleman from the back of the hall. He announced flatly that such matters were not our concern, but that the whole subject of academic standards and professional qualifications had been reserved by the Treaty of Rome for the Commission in Brussels; he added that he was the official responsible for these things. We had a violent public altercation. I reminded him that he and his colleagues had been arguing for 10 years and that all their proposals had been rejected by the Ministers of the Six. I felt that it was time the universities had a go. I have always known that uniformity as such appeals very much to many continental administrators because it simplifies their work. This is not our way of doing things, but the Commission wants to standardise the education which professional men have before they can qualify. It hopes that it will then be easy for them to move freely throughout Europe. It insists furthermore, that, in order to standardise the product as it were, even those professional men who want to stay at home must take the same courses as those who want to migrate.

The Commissioners have always known that their ideas would be unwelcome in England, so during the year which has just elapsed, when we have been on the brink of membership, but still outside the Market, they have redoubled their efforts to force agreement among the Six so that we would face a fait accompli on 1 January, 1973. I am glad to say that they have failed.

Take one example. Our English chartered accountants had been expecting that after we have joined the Market they will be able to practise all over Europe and that they will welcome a few Frenchmen and Italians and Germans in exchange. The Commissioners recently proposed that an aspirant chartered accountant who is going to be an auditor must take a four-year university course followed by three years of supervised tuition and another three years of practice before he qualifies (there are alternatives which I shall not describe now). Last month [December, 1972] the general secretary of the Institute of Chartered Accountants announced that if

we allowed the Commission to have its way more than 50 000 of the 78 000 chartered accountants in this country will be unable to practise as auditors either in England or in Europe after 1977. Furthermore he said that the course which the Commission proposed was quite inadequate and would not be acceptable in England. The English professions are governed and controlled by professional societies, all of which, like the universities, have Royal Charters. The charters define the legal rights, privileges and duties of the institutions and their members in considerable detail. All these learned bodies have one particular duty which they derive from the ancient tradition of our mediaeval guilds. They are responsible for recruiting their new members.

A man cannot matriculate and become an undergraduate unless some university accepts him—and his qualifications. A man cannot graduate or be appointed to the staff of a university until the Senate approves; senior chartered engineers and accountants assure themselves of the quality of the men whom they admit to their fellowship. No man will be admitted to the medical profession unless and until the General Medical Council has been satisfied with his education—his experience and his examination results.

A man must have experience of both theory and practice before he can be admitted as a fully qualified member of any profession. Many of the learned professions set their own examination papers, but some of them allow aspirant members to take a university degree instead and accept it as the equivalent of part of their own exams. Most professions demand some form of postgraduate apprenticeship, which may have to be served in a teaching hospital or a barrister's chambers or in an engineering works or on a building site or in a bank or in an accountant's office as the case may be.

Most professions change their regulations from time to time in order to keep up with the changes in the nature of professional life. Only a minority of our English engineers ever went to university, but times change and, as we all know, it is going to be much harder for non-graduates to become chartered engineers in future. Other professions are following the same road.

It is a never ending source of astonishment both in England and on the Continent that an Englishman can become a barrister—and even a High Court Judge, without ever setting foot in a university (at least a quarter of our "silks" are non-graduates). One must sympathise with Commissioners who are trying to rationalise all this—especially because a great many Englishmen like the system as it is.

On the Continent every student who has his school leaving certificate (Baccalaureat or Abitur) has the right to go to the university of his choice—whether or not it has any room for him, and he gets his professional qualification by taking either a state examination or a university degree in an institution which

is under direct government control and all of whose staff are civil servants. Some continental universities are so crowded that they have to get rid of most of their students long before they can graduate. Some French universities admit all comers and then fail 70 or 80 per cent of them after a year or two. Some medical schools accept several thousand freshmen every year although they haven't room for more than a hundred or two in the teaching hospitals.

One in three graduates

In a nutshell, we select our students before they come to university. We give them a short intensive three-year course and nearly all of them get a degree when they leave. Continental universities admit everyone, select the best of them while they are in university, give them a long and rather disorganised course and give a degree to one man in three—or sometimes to only one in 10. Those who do graduate are usually accepted as qualified professionals—unless they were foreign born. Both systems have advantages and disadvantages, but we couldn't adopt continental practice without pretty well wrecking our schools and our universities in the process.

The Commission is trying to impose a homogeneous pattern on continental universities and professions, and then it will expect us to accept it. It wants to assess the standing of all professional men by counting the number of hours in their university course, but it proposes to pay no regard at all to the quality of the teaching or to the equipment in these universities.

It is nearly 50 years since the British Medical Council stopped counting the contact hours in our medical schools. It was impossible to do it effectively; it was useless—it was irrelevant anyway. The General Medical Council visits our medical schools, architects inspect schools of architecture and occasionally strike some of them off their lists. So, in fact, do all our professional bodies. The Brussels Commission is, on the other hand, trying to insist that accreditation must be entrusted to bureaucrats who will do no more—and no less—than count contact hours and judge each course accordingly. It is instructive to consider three directives which have been issued during the course of last year about medical education, because the Commission nearly forced through an "orientation commune" among the Six only a week before Christmas. The first directive provides for the rights of migrants; they must be able to register with public organisations or with professional bodies in the same conditions as natives of the member state to which they move. They must have the right to join, to vote and to be elected to office in any professional society, such as the British Medical Association or the General Medical Council.

The second directive requires member states to recognise medical qualifications granted to nationals in other member states if they fulfil conditions which are included in the third directive. This requires that a doctor shall be admitted after he has satisfactorily completed a course of training in a

university which lasts for a minimum period of six years which must include theoretical and practical training extending over at least 5500 hours.

Our representatives attended some of the meetings as observers. They remarked that these directives are concerned with private practice and that the National Health Service is fundamentally public. They pointed out that the General Medical Council was solely responsible for the registration of doctors in this country, but that we have no particular statutory registration about clinical specialities.

Our people suggested that an international body should be set up along the lines of the General Medical Council to advise the Commission about standards of medical men from all parts of Europe, but the idea was rejected by the Commission, who claimed rather curiously that it would be an infringement of the autonomy of the universities were the bureaucrats to inspect them. Our medical men can breathe again, they may have been saved by arguments about the weights of lorries and by that strike in Brussels, but it was a near thing.

The Commissioners are confident that we are going to accept European standards. Are we? I do not understand how and why any association of professional men can be compelled to accept new colleagues who have been educated in a manner of which they disapprove. I do not believe either that professional Englishmen are going to disenfranchise half of their colleagues because of proposals which have been drafted in Brussels by bureaucrats who know nothing about local problems. Are these things really going to happen?

I have come to believe that the future of the professions will probably be determined by mechanisms which have not yet been contemplated by the Commissioners in Brussels. Before long a professional man's livelihood will depend almost entirely on his ability to get cover from a reputable firm of insurance brokers. I believe that under-writers will be influenced far more by their own estimate of a man's professional competence and by the judgment of his professional colleagues than they will ever be by his paper qualifications, whatever the Commissioners may say in Brussels. I expect that sooner or later we shall have to devise some method of assessing the standards for every profession. We want a system that we can accept and which does not raise insuperable problems for our partners in the Community. A small Cabinet Committee of government officials in Whitehall watches developments in the EEC which will affect higher education here and it has a working group under the Department of Education and Science.

We have been in a difficult position for a year or more, but in my opinion the British government has already conceded far too much by accepting the principle that negotiations about professional standards can be undertaken by government officials. The professions must be allowed to choose their own plenipotentiaries in the future.

VISIT POLAND

THE LAND OF COPERNICUS

15 DAY AIR HOLIDAYS FROM £57

COPERNICUS TOUR £79

(including 4 days in wildlife reserve)

FOR FULL DETAILS WRITE TO:—

**POLISH TOURIST INFORMATION CENTRE,
313 REGENT STREET,
LONDON W1R 7PE.
TEL. 01-580 8028**

NAME

ADDRESS

.....

.....

The Copernican revolution

On 19 February the world celebrates the quinqucentenary of the birth of Nicolaus Copernicus, the great Polish astronomer who first advanced a detailed planetary system in which the Sun formed the centre. He was a man of many parts

J. G. Crowther is a former director of the science department of the British Council and was for 20 years science correspondent of the *Manchester Guardian*. He has written many books on the social aspects of science

Before Copernicus the universe was regarded as a comparatively small rigid sphere revolving around the Earth as its centre. To this sphere were attached twinkling points of flame. These were the stars, fixed in their positions in relation to each other. Inside the sphere were smaller spheres, or wheels, also centred on the Earth, which carried the Sun and planets in their revolutions round the Earth.

Observation showed that the heavenly bodies did not move exactly according to such a simple arrangement. The Greeks found that a more precise description could be given, if the centres of the planetary circles were not quite at the centre of the Earth, and the planetary paths were treated as combinations of circular motions. Ptolemy of Alexandria in the second century AD worked this system out in detail, invoking about 80 circular motions. His system was sufficiently exact to meet the practical demands for astronomical forecasts for more than a thousand years.

Towards the end of the Renaissance the social, cultural, and economic development had created a pressing need for more exact astronomical information. The Church, which was the custodian of time and the festivals which regulated the periods of operations in an agricultural society, was troubled by the accumulating errors in the calendar. If time was out of joint, then society was out of joint.

Star tables based on Ptolemy had been sufficiently accurate for navigating under night skies on short coastal voyages, but when ships ventured far out to sea they were found to be inadequate.

Together with these increasing practical demands there was an aroused interest in knowledge, reflecting the expansion in social activity typified by the search for, and study of, classical literature and science.

Such was the situation in the world when Nicolaus Copernicus was born on 19 February, 1473, in the Polish town of Torun, near the Baltic coast on the River Vistula. His father was a copper merchant who engaged in considerable property deals. His mother's brother Lucas Watzelrode was a canon of Frombork Cathedral, the seat of the Bishop of Warmia who, in that age of prince-bishops, was the effective ruler of a province which included a considerable part of Prussia.

When Copernicus was 10 his father died, and his uncle became his guardian. Lucas Watzelrode presently succeeded to the bishopric of Warmia. He became an important Polish Church- and statesman, who for a long time was more famous in Polish history than his nephew. He brought up Nicolaus as his protégé, apparently grooming him as his intended successor. Nicolaus was sent to Cracow

University in 1491. It was then the best university in northern Europe, with flourishing schools of mathematics and astronomy, and a centre of contact between Europe, Russia, and Asia. He attended the lectures of Brudzewski, the editor of Purbach and Regiomontanus.

Then his uncle sent him to Italy, where he studied no less than ten years. When he was 24 his uncle had him appointed a canon of Frombork, so he had a secure income for life. He went first to Bologna to study law, to equip himself for administration on behalf of Frombork. He never took any higher theological degree; he spent most of his time studying astronomy and mathematics, painting, and mastering Greek. The latter gave him direct access to the writings of the ancients. His teacher at Bologna was Novara, one of Regiomontanus's pupils, who had redetermined the positions of all the heavenly bodies mentioned by Ptolemy.

When the ancient and modern positions were compared it became evident that the aspect of the heavens had changed greatly since Greek times. This focused attention on the mechanism of the heavenly motions. Novara probably discussed the problem with his pupil, and told him that some of the Greeks had unorthodox ideas on it.

Copernicus returned to Frombork in 1501, but without a degree in law. As he was interested in astronomy the brethren thought he had better make himself useful by qualifying in medicine. According to the traditional astrology and microcosm-and-macrocosm theory, in which the actions of the body were supposed to correspond with those of the stars, a good knowledge of astronomy was regarded as a sound foundation for a medical training. Later on, the Copernican theory was to undermine astrology. One of the marks of Copernicus's greatness was that though he was surrounded and taught by believers in astrology, he was completely uninfected by it.

He went to Padua, and then to Ferrara, where the heir to the dukedom, Alfonso d'Este, and his wife Lucrezia Borgia, were flourishing. There he remedied his lack of a degree in law, a doctorate in canon law being conferred on him by the Archbishop of Ferrara, another of the Borgias. Then he went back to Padua to continue his medical studies.

At the age of 33 he returned home, learned in mathematics and astronomy, law and medicine, and a competent portrait painter. In the tower of Strasbourg Cathedral there is a copy of a copy of his self-portrait.

The mature postgraduate research student was now given further leave of absence to become secretary, personal physician, and protégé of his uncle, the bishop. He participated in the conduct of political, diplomatic,



and administrative affairs, and pursued his scientific studies in his leisure. After the death of his uncle he returned to Frombork. During a vacancy in the bishopric, however, he acted as general administrator, and actually ruled the province for six months.

Copernicus had to manage public affairs in a very difficult period. The struggle between the King of Poland and the Teutonic Knights had disorganised the economic life and trade in the Baltic provinces. Military commanders coined their own money, and the currency throughout the region became devalued. In addition to this, a ruinous inflation had spread through Europe owing to the flood of gold arriving from the recently-discovered New World.

Copernicus addressed the Prussian Diet on the problem of inflation. His views on it, like those on astronomy, were profound. He said that when rulers of a country tried to make a profit out of currency by adding bad coin to good, they not only harmed their subjects, but themselves. They were "like a stingy farmer who sows bad seeds in order to save good ones." During the first half of the fifteenth century the Prussian currency had lost half its value. "The goldsmiths alone draw profit from this ruin of the country." In order to combat the inflation there should be a new uniform coinage, and it should be laid down by law that twenty marks should contain one pound of fine silver.

In 1527 he elaborated his views. Among the innumerable evils which brought about the

The ancient courtyard of Lidzbark Castle, seat of the Bishop of Warmia. Copernicus served here as aide and medical advisor to his uncle, Bishop Lucas Watzelrode



Copernicus holding a lily-of-the-valley. A copperplate engraving.

ruin of states the most important were inner dissensions, high mortality, barrenness of the soil, and inflation. The fourth was the most insidious because "the states exposed to this evil do not perish at once from its first attack." With bad money the poor could not buy bread, but those who minted it, and a few traders, grew rich.

"Moreover, trade and communication, arts and crafts flourish where money is good. With bad money, however, the people grow slack and inert, they neglect cultivating the spirit. . . . It is quite clear that light money furthers laziness and in no wise relieves misery. . . ." He discovered Gresham's law twenty-two years before Gresham, pointing out that it is a mistake "to introduce new, bad money beside the old, good money; for the bad not only devalues the old, better currency, but drives it away."

In his responsibility for the well-being of the peasants on the Frombork estates, he recommended price control, to prevent the poor from being harmed by the inflationary rise in the cost of bread.

Copernicus's joint concern about astronomy and economics was not a historical accident. One of the motives that had inspired the contemporary development of astronomy had been the great navigations, a main aim of which was the search for gold. They resulted both in the discovery of the New World, and gold. The geographical discovery at last convinced general opinion that the Earth really was round, and its sphericity was not merely a mathematical fiction.

When Copernicus became aware of the need for a better theory of astronomy, he searched the literature of the ancients for their views. He was first struck by a passage in Cicero, in which it was related that a



This page of the manuscript of *De Revolutionibus* shows Copernicus's own drawing of the solar system with the Sun at the centre and the planets arranged around it in their present order

Syracusan philosopher had believed that the heavens stood still, while the Earth rotated. In Plutarch he found that Heraclides of Pontus and the Pythagoreans held similar views.

He was particularly impressed by this passage, and wrote: "When from this, therefore, I had conceived its possibility I myself also began to meditate upon the mobility of the Earth. And although the opinion seemed absurd, yet because I knew the liberty had been accorded to others before me of imagining whatsoever circles they pleased to explain the phenomena of the stars, I thought I also might readily be allowed to experiment whether by supposing the Earth to have some motion, stronger demonstrations than those of the others could be found as to the revolution of the celestial sphere."

Then he "found at length by much and long observation," that "if the motions of the other planets were added to the rotation of the Earth and calculated as for the revolution of that planet, not only the phenomena of the others followed from this, but also it so bound together both the order and magnitude of all the planets and the spheres and the heaven itself, that in no single part would one thing be altered without confusion among the other parts and in the universe."

He showed that the number of circles required to describe the movements of the heavenly bodies could be reduced from Ptolemy's 80 to 40, if the heliocentric hypothesis was adopted.

As a canon he had lodgings at Frombork in a tower near the Baltic. He made astronomical observations with simple instruments, collecting data on points where his theory differed from Ptolemy's. He watched the rising and the setting of the Sun and stars, and complained of the fogs that obscured his observations. In 30 years he never succeeded in observing Mercury, which was very important for his theory, owing to the height of the latitude of Frombork, and the sea mists.

In 1506 he began to think of expounding his work in a book. About 1512 he wrote an outline of his theory, which he circulated to some of his friends. His astronomical reputation rose, and in 1514 he was invited by the Pope to serve on a commission for the reform of the calendar. He declined, on the ground that the data were not yet good enough for a satisfactory new calendar to be made.

The material for his book was probably complete by 1529, for the latest observations it belong to that year. He worked on it steadily, in the intervals from his duties as an administrative canon of Frombork.

Copernicus's wide culture, experience of affairs, and practical ability were as important as his intellect in his achievement. He had the strength, wisdom, and patience not to expose himself to, and be frustrated by, ignorant and vicious opposition. The prime difficulties with his theory were not technical but imaginative. Among the technical improvements which his theory immediately provided was a simple explanation of the stationary points and retrograde motions of the planets. He showed for the first time that the dimensions of the planetary orbits could be calculated, in terms of the distance of the Earth from the Sun. The relative distances which he worked out were substantially correct. Ptolemy's system gave no measure of the distances of the planets.

Copernicus's theory did not immediately offer much advantage to practical men, for they were used to tables based on Ptolemy, and had learned to employ them with empirical corrections gained from long experience. It was true that it offered simplifications, but it still retained perfect circles which did not entirely fit the facts.

There were other difficulties of a deeper nature. If the Earth and heavenly bodies were in motion round the Sun, the stars ought to appear in different positions when viewed from opposite ends of the Earth's orbit. The absence of any detectable parallax indicated that the stars must be prodigiously distant. It was this fact which prevented the great observational astronomer Tycho Brahe from accepting the Copernican theory.

Copernicus's intellectual courage and judgment in accepting the implication that the universe must be vast, if not infinite, was a crucial part of his genius. He showed, too, a similar insight in recognising the importance of gravity as a holding force in the

universe. With the abolition of the little old rigid universe, it was necessary to find alternative forces which were holding celestial bodies together.

The general difficulties raised by the abolition of the egocentric universe were more serious than the technical imperfections in Copernicus's work. The revolution in man's view of himself and his place in nature, when he realised that he was not at the centre of the universe, but a speck whirled through a gigantic space, was far greater than the mere technical change in astronomy. It brought all things under question. It undermined astrology, and helped man to take a more detached view of himself and nature. It enabled objective sciences of physiology, psychology, and society to be conceived, and medicine to be put on a rational basis.

Few men could stomach the revolutionary new view. When Martin Luther heard about it he commented: "... such are the times we live in: he who wants to be clever must invent something all his own and what he makes up he naturally thinks is the best thing ever! This fool wants to turn the whole art of astronomy upside down! But as the Holy Scripture testifies, Joshua ordered the Sun to stand still, and not the Earth!" Melanchthon said that in the face of such theorising, "wise rulers should tame the unrestraint of men's minds."

Yet Copernicus's first important disciple was from Luther's and Melanchthon's own

university of Wittenberg. This was the young mathematician von Lauchen, one of Melanchthon's pupils, who adopted the Latin name of Reticus. Fascinated by Copernicus's ideas he set out at the age of 25 to journey to the Baltic, and to meet their author. Copernicus was then 66; they took to each other, and Reticus swiftly mastered Copernicus's ideas and papers. He urged and assisted him to complete his book. He saw it through the press, and ensured that a copy was placed in his hands before he died in 1543. Reticus did for Copernicus and *De Revolutionibus* what Halley was to do for Newton and the *Principia*.

The only other scientific work in modern times which can be compared with Copernicus's *De Revolutionibus* is Darwin's *Origin of Species*. This also produced a revolution in general thought as well as in science. But Copernicus's revolution came first, and in that respect was the greater. The theories of the heliocentric universe and of evolution owed their exceptional range and importance to the depth of their inspiration; they arose out of fundamental features and concerns of the human societies of their times. In both cases they were much more than technical extensions of particular branches of science.

In the Renaissance, society was in motion, its conceptions were in motion, and it became easier for it to see that the universe was also in motion. Copernicus expressed the supreme idea of the age.

PEKING

PIA make the destination news of the year

LONDON

ISLAMABAD

PEKING

KARACHI

On Saturday the 20th January, PIA opened its new, twice-weekly service to Peking - and took a flight into history.

What does PIA to Peking mean to the air traveller?

Twice-Weekly Flights to Peking.

PK 704 Every Wednesday.

Depart London 0915, Paris/

Damascus/ Baghdad/Karachi/

Islamabad/Peking/Shanghai.

PK 712 Every Friday. Depart

London 0915, Paris/Rome/Cairo/

Karachi/Islamabad/Peking/

Shanghai.

PIA Cuts Flying Time to Peking on Standard Routes by 4 1/2 hours.

By flying north from Karachi over the mountain range of the Karakoram, PIA slashes 4 1/2 hours off the old flying time.

By taking the shortest possible route (3,192 miles), ... in the shortest possible time (7 1/2 hours).

No Extra Cost to Fly on to Shanghai by PIA.

After Peking, PIA fly on to Shanghai - at no extra cost. What's more, from Shanghai, PIA can arrange fast, convenient flights to Canton (previously a PIA destination through CAAC).

PIA PAKISTAN INTERNATIONAL AIRLINES

Feedback

Royal doomwatcher retires

Sir Eric Ashby, who retires at the end of the month after three years as chairman of the Royal Commission on Environmental Pollution, was in an unrepentant mood when he talked to a group of eco-journalists last week. His main thesis was a dilemma faced by both royal commissioners and science journalists: the cocktail party effect. As everyone talks louder about the environment, one is tempted to make even more fearful prophecies purely in order to be heard. All science is a matter of selecting facts, he argued, so leaving out the small print is nothing peculiar to environmental propagandists. But when does simplification become distortion? Sir Eric, who is a polite and civilised man, merely asked the question of his audience, and proffered no opinions of his own.

He did, though, reveal some of the difficulties of exerting influence on

Whitehall. His commission has never dared leave out the small print, for DoE officials zealously examine each report for errors. If they can present their Secretary of State with a list of 12 inaccuracies, its arguments are damned for ever. Ashby describes his fellow-commissioners as "not a committee of experts, but a group of rather respectable elderly gentlemen who are assumed to be disinterested". Their reports not only have to be proof against the attacks of an often-hostile civil service, but written "in language simple enough to be understood by MPs—far harder than explaining things to you chaps".

How much influence has the commission had, and what changes would he like to see in it? Ashby thinks the press have done far more to shift government than he has. "On environmental issues, politicians have been parasitic on the mass media—if a subject doesn't become

a matter for public concern then they're not interested in it". He admits, though, to having possessed the power of blackmail, by threatening to produce a public report if a department refused to take action. He does not think his own commission's scope should be widened to include resources, population, and economic growth, but would like to see parallel royal commissions covering these areas.

His unwillingness to deal with growth may not be unconnected with the personality of the sole economist in Ashby's team—Professor Wilfred Beckerman, who holds uncompromisingly to the view that resources are inexhaustible and GNP can soar ever-upwards. In a few weeks time, Sir Eric Ashby gives way to Sir Brian Flowers, who will retire from chairmanship of the SRC in the autumn. A mere 49, Flowers may well wish to see the retirement of some of his more contumacious elderly colleagues. Out of the remaining seven commissioners, five are aged 65 or over.

Doomed dams?

Public hearings in Washington DC last week marked the end of four years of evidence-gathering by President Nixon's National Water Commission, established to evaluate the United States' water resources, demands and policies. All the signs are that when it reports this summer, the commission will call for a drastic cutback in the controversial dam, drainage, channelisation and canal projects of such federal agencies as the Army Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service and the Tennessee Valley Authority.

Environmentalists have been claiming for years that most such schemes are not just unnecessary but ecologically disastrous as well. Typically, flood damage to

buildings and crops in a river's natural flood plain is used to justify a series of dams, or soil erosion caused by bad husbandry cited in support of confining a river to a neat concrete bed. Corps of Engineers or Bureau of Reclamation projects are financed almost entirely by the federal taxpayer, but the benefits are reaped mainly by local landowners.

Political support for "taming" a river is stimulated by maps which demonstrate that acres of land previously liable to flooding will now be suitable for building. The meadowlands are drained and concreted, the real-estate operators make huge profits, and there is more low-lying property liable to flooding. Rising flood damage claims in their turn justify new reclamation schemes, to the benefit of contractors and GNP but not the environment. Canalisation projects have



similarly developed a momentum of their own: the famous Cross-Florida Barge Canal was originally proposed in 1942 to protect coastal shipping from German U-boats, but the blueprints remain today as a potential threat to the water balance of the Everglades.

The National Water Commission's draft report recommends local sharing of the cost of water projects, and greater reliance on non-structural methods of flood control. If Congress and President are persuaded to slash water agency budgets, one likely casualty will be the scheme to convert Fort Worth, Texas, into an inland seaport at a cost of \$1300 million to the taxpayer.

Weinberg on leave of absence

Alvin Weinberg, director of the Oak Ridge National Laboratory (ORNL) since 1955, is off on a six months leave of absence. He intends to spend the first 1½ months at the Woodrow Wilson International Centre for Scholars in Washington writing a book to "correct mistakes made in an earlier book, *Reflections on Big Science*". This is to be followed by two months as visiting scholar at Vanderbilt University and then a summer sojourn at Cornell. Dr Weinberg told New Scientist that he intends to return as ORNL director and denied that his departure was the result of pressure either by the AEC or by Union Carbide, the AEC contractee that actually runs ORNL. Weinberg has

been particularly critical of the commission's emphasis on one breeder design, the Liquid Metal Fast Breeder, and there has been speculation that pressure was brought to bear on Union Carbide to remove him as director. Somewhat ironically, Weinberg's leave comes at the time when ORNL has received the bad news that its 1974 fiscal year will be without funding, about 95 million, for its molten salt reactor programme, one alternative to the ex LMFB. Acting director in Weinberg's absence will be the ORNL deputy director Floyd L. Culler Jr, 50, a chemical engineer who made his reputation on electromagnetic separation of uranium isotopes nuclear fuel reprocessing, and nuclear waste disposal.

Science policy in the French elections

The French general election next month is widely expected to produce, if not a change of government, at least a swing away from the present Gaullist majority and an advance of the parties of the Left. Topics such as the shape of Europe's space programme, state participation in research and development and the structure of France's education system in the light of modern scientific and technological requirements are very much in the air. The monthly review, *La Recherche* in its February issue publishes the views of a number of senior politicians

on science policy. M. Jean Charbonnel the present Minister of Industrial and Scientific Development and M. Michel Poniatowski (secretary general of the Federation of Independent Republicans) speak, though discordantly, for the majority parties. The opposition is represented by M. Roland Leroy (communist), M. Michel Rocard (son of Professor Rocard, "father" of the French atomic bomb, and leader of the United Socialists) and M. Jean Jacques Servan Schreier (for the Radicals). At the last minute a statement of the views of M. Francois Mitterand, the Socialist leader, was held out at the request of the party Secretariat.

M. Charbonnel expresses himself content with the research structure as it is. "It is at the application level that the problems present themselves." It is essential however to engage small and middle-sized firms more closely in research and innovation. The national plan which says down the direction of development in this field seems to M. Charbonnel to be generally on the right lines and anyhow, he adds, it seems that the opposition has suggested no alternative. M. Leroy thinks otherwise. A left-wing coalition government, he says, will reverse the present policies so as to end the scientific recession and induce a general growth of effort. It would revise the main priorities. Research expenditure should rapidly reach 3 per cent of the gross national product and there would be a considerable increase in the employment of scientists. Regarding the space programme M. Leroy wants to see France taking an important part and he predicts changes in the military nuclear policies.

M. Poniatowski demands greater coherence between methods and objectives. He would like to see all the research funds re-grouped including those for military research, if possible—State support should be concentrated in the "classic" areas rather than in specific project sectors. In space, France should avoid tackling alone a policy incompatible with her resources. He would also like the Economic and Social Council to have a science section to evaluate the consequences of plans under examination.

M. Rocard believes that, under de Gaulle, France had a research policy which was controversial but credible. "Since Pompidou came to power there has not been even a policy." Science policy, he says, should be decided by the whole community. He wants none of a European research policy in a Europe that is capitalist.

M. Servan Schreier denounces the belief in the sanctity of research. Declaring that research projects on a European scale will have no hope of success unless they are backed with a single political will, he considers that the hasty patching-up of small national projects is a waste of public money.

Shockley debates with blacks

Professor William Shockley the Nobel prizewinner, whose proposal to offer financial incentives as a way of reducing births of less intelligent children has aroused fierce controversy on the campuses of the United States, has recently taken part in a series of debates in-



volving black scholars in California. A crowd of more than 1800—mostly students—turned up at the Stanford Memorial Auditorium last month for a discussion which went on for four hours. Shockley, in his opening remarks, suggested that black students at Stanford take part in a research experiment to test his "tentative prediction that for each one per cent of Caucasian ancestry, average IQ of American black populations goes up approximately by one IQ point". Professor L. L. Cavalli-Sforza, head of the genetics department, doubted very much that the study would be valid, since Stanford students were so highly selected. Professor Dubois McGee, a psychologist, went further, arguing that blacks faced "mental enslavement" if they allowed "white scientists to tell us what we think, what we believe... where our roots are".

At another point in the debate Professor Cavalli-Sforza criticised studies of white identical twins raised separately which had been cited by Shockley as the "cornerstone" of his belief that genetic differences account for about 80 per cent of IQ differences. Those studies were of only "limited" value because most observation had been done at the same age, IQ, he said, changed very considerably during the life of the individual.

The last word on . . .

The social significance of double-top

The newspapers seem generally to have met with mild surprise the report from the Opinion Research Centre that their sporting surveys have shown darts to be the most popular active pastime in the country. About ten per cent of the adult population say they play the game; and since, from personal observation, the great majority of dart-throwers are men, this suggests that the thick end of twenty per cent of adult British males participate. For the fairly obvious reason that darts is one of the few active sports at which you can legitimately get boozed while participating. There is no other standing-up and walking-about pastime within my spectrum of dalliance in which the playing area is within arm's-length of a bar.

But this comforting proximity of alcohol to the pursuit of double-top is not the only social benison that the practice of dart-throwing can bring to our present inhibited culture. Violent atavisms of hurling flint-barbed spears at dinosaurs or deadly javelins at classic hordes are sublimated in the twentieth-century fourale bar by flicking plastic-feathered arrows at treble-twenty. And such satis-

faction of the hunting instinct keeps the lower classes away from blood sports, and leaves these higher activities uncrowded for the id-comfort of members of the Royal Family and denizens of the King's Dragoon Guards. The spread of education is assisted by the requirement that each team takes the chalk in turn and practises multiplication, addition and subtraction during their stint at the scoreboard. Which is a contribution to the growth of numeracy among the masses only equalled by the instruction in permutations and combinations benevolently disseminated by our football pool promoters. Blessed release is also provided for frustrated British treadors who can find symbolic fulfilment of their banderillo ambitions in hurling gaudy-coloured darts at the hull.

For the inexpert majority, the launching of a dart is as much a lottery as that recorded by H. W. Longfellow when he shot his arrow into the air and it came to earth he knew not where. This heady feeling at each throw that it's an even chance whether you'll hit a double or the skirting-board provides dartsmen with a harmless outlet for gambling

instincts which other people have to assuage at the betting-shop or gaming table. It is not generally wise for those of eccentric aim actually to gamble on their own celerity in making three-hundred-and-one, since there is a fair incidence among our darting millions of deadeye dicks who invariably get a double in their first go, score centuries at each succeeding turn, and finish off the game with an arithmetical flourish before you've had the time to get past the froth on your first pint. But even they can eventually be defeated by the tyro by the application of a little behavioural science and a touch of the Stephen Potters.

Gamesmanship advises that, to win at darts against a superior player, just as the score gets to the screwing point, you should humbly beg his advice on a matter of technique. "Could you tell me?" you ask him, "When you prepare to throw your amazingly accurate darts, do you look at the point of the dart, or at the dartboard itself?" Being naturally gifted with a good aim, he's never thought about how he does it. He henceforth tries to work out whether he does in fact look at the dart-point or the required double, his whole game goes forthwith to all hell and hitting lampshades, while you plod laboriously home to win after thirty-two minutes on one-double-one. *Patrick Ryan*

Forum

Westminster scene

Dangers of atomic secrecy

When it eventually took place, the Second Reading debate on Aldermaston obtained the attention of precisely eight MPs. Admittedly, the Minister, Ian Gilmour (not yet but soon, I suspect, to be a member of the Cabinet), assured us that it was not about the control of nuclear weapons, and was a simple measure transferring responsibility from the Department of Trade and Industry to the Ministry of Defence. But, 10 or 15 years ago, such a topic would have been a major Parliamentary occasion.

It is said that Mr Harold Macmillan, brooding in Birch Grove, still peruses Hansard. What he thought, heaven knows! Or the shades of Nye Bevan and Hugh Gaitskell, whose political life was at one time so dominated by the nuclear issue. If anyone had told me in October 1960, when I was a brash young delegate to the Labour Party Conference at Scarborough, that 13 years later I should take part in a highly academic debate on nuclear weapons which would collapse, one hour before schedule, through lack of interest, I simply would have looked at them incredulously. After all, it seemed then that nuclear weapons was the issue of the century.

Tony Wedgwood Benn (Bristol South-east), put on the spot by a damaging and able attack by Gilmour, made one of his best speeches—and this means very good indeed, because he is a tremendous “presenter of a case”. One argument struck me in particular. If we blank out public debate for security reasons, he said, we also blank out Ministerial debate. This is because a Minister discussing housing policy, education policy, or roads policy is informed by reading in the press at the time of the debate, as it occurs, by intelligent comment from outside the government. He reads what the education correspondent of *The Guardian* says, or what the environment correspondent of *The Times* says. He has the benefit of what professors writing from the universities may say. But, as Benn pointed out, in the nuclear field, a Minister has no such advantage; the cloak of secrecy, which he acknowledged as necessary, is so great that the Minister is entirely dependent on official advice. He cannot challenge that advice. He probably has no qualifications to challenge technical advice. He has nobody whom he can bring in, like all those economic advisers whom Ministers bring in to the Treasury, to ask whether there is only one way of conducting a policy.

Benn deduced that it was therefore important in the special circumstances of the nuclear field that there ought to be at least two senior Ministers, not just

one, with a finger in the nuclear pie.

Gilmour made much of the argument that nuclear policy was not simply on a Departmental basis, but touched the very heart of the collective responsibility of the Cabinet. There is a big “yes, but . . .” to this comforting argument. In fact, such delicate matters tend to be the preserve of the Overseas Policy and Defence Committee of the Cabinet, if not of the Prime Minister, the Defence Secretary, and two or three other Ministers. Herbert Morrison in his heyday was not aware of Atlee's acquiescence in the making of a British A-bomb. I hope to hear more on this subject during the Committee Stage of the Bill.

The project definition study on the Harrier is still not yet complete. John Wilkinson (Bradford West) wants a Harrier on the new through-deck cruisers—at a cost of £60 million plus apiece. He claims that export orders for the naval variants of this unique and exciting plane may hang on a British naval



service requirement. Sir Richard Thompson (Croydon South) took another view. We ought to bear in mind that for years, he said, we have been awaiting a satisfactory outcome from all the trials and experiments. Would the Minister prevent the admirals from having too much to do with designing naval aircraft? “Does he realise that many of us suffered from this during the war, and will he insist on getting an aircraft, not necessarily perfect, but capable of taking off from the deck?”

Above all, we ought to be clear about just how rapidly the Harrier-type jump-jet technology will be able to spill over into civil aircraft. An accurate assessment of the time-scale and practicability/cost/safety of a civil Harrier is germane to the current argument raging over the future of Maplin, and whether London needs a third airport at all. I do not think that domestic air services will expand significantly. Indeed, with the arrival of the advanced passenger train, Edinburgh and Glasgow traffic to London could fall off just at the time a third London Airport would come into use.

A group of MPs, including Sir Ronald Russell (Wembley South), a veteran Conservative campaigner on animal welfare, and Douglas Houghton (Sowerby), chairman of the Parliamentary Labour party, are urging the government

in an Early Day Motion to set up a research institute, under the auspices of the Medical Research Council or some other authority, to enquire into alternative methods of research not involving the use of live animals. They want the government to propose an amendment to the 1876 Cruelty to Animals Act, to ensure that where alternatives are available, they will be used. In 1971, 5 607 435 experiments were performed, 86 per cent of them without the use of anaesthetics.

So far, they have the support of 53 other Members of Parliament of all parties. The head of steam behind the campaign is considerable, and a large number of letters are coming to MPs. My instinct suggests that the cruelty societies and their supporters will soon get their way. If so, it will be one of the comparatively rare examples of a public campaign making a real difference to what happens.

A cute little exchange at Scottish Question Time. John Brewis (Galloway) wanted to extend the grants under the farm improvement scheme to fish farmers. The Under-Secretary, Alick Buchanan-Smith, did not consider that agricultural grants schemes are appropriate for the purpose. Brewis then chanced his arm and suggested help for fish farm grants under the Industry Act. Yes—to everyone's astonishment—fish farming might qualify under Part II of the Industry Act. *Tam Dalyell MP*

Washington view

Nixon's budget cuts for R & D

Within the research community, as elsewhere among the numerous retainers of the federal treasury, rumours of new financial stringencies abounded before 29 January, when the President published his budget for the fiscal year starting 1 July. But the forecasts, pessimistic as they were, are now revealed to have been insufficiently pessimistic, for virtually all across the board Nixon's fiscal designs reflect a demand for quick payoff from R&D and damn the long-term implications. Thus, the National Institutes of Health, the financial mainstay of biomedical research, has been directed to terminate its training programmes because “in view of the improved supply/demand balance in research manpower, it seems appropriate now to rely on the normal mechanisms in the professional manpower market to produce any additional manpower needed”. The well-publicised “war” on cancer and heart and lung disease will receive budgetary increases, but most of NIH's other research programmes are going down. High-energy physics, which has

been on a subsistence budget for several years while the National Accelerator Laboratory at Batavia, Ill., has increasingly eaten into the overall budget, is being subjected to further tightening, with NAL's fund going up, from \$19 million to \$29 million, while spending on the nation's five other major accelerators declines. The National Science Foundation, the key agency for academic basic research outside the biomedical field, has been given what is essentially a standstill budget for support of individual research projects. This means that with inflation and still more manpower coming onto the market, competition for its funds will be keener than ever; and NSF is also cancelling its traineeship programme.

The totals that the government will spend on R & D are still colossal in terms of what other nations, individually or in combination, allocate to scientific and technical activities—\$16.7 billion. In fact, there is even an element of growth from this year to the next, for the current annual expenditure is estimated to be \$15.8 billion. But there are a lot of mouths around that trough, backed up by hungrier ones waiting a turn, and what is becoming clear as analysis of the budget proceeds is that there is considerably less to it than is apparent at first examination.

The increase from this year to the next, totalling \$904 million, includes some \$600 million originally scheduled to be spent in the current year but withheld and, in many instances, tacked onto spending plans for next year. Thus, a large part of the "increase" is simply the result of deferred spending swelling the figures of the future. Of the \$904 million increase, \$460 million is assigned to the Defense Department, which, together with the Atomic Energy Commission's military activities, consumes, as usual, well over half of the government's R & D expenditures.

The relatively little growth on the "civilian" side of the budget is mainly concentrated on energy and environment, but here, too, the budgetmakers felt no restraint about pruning. The Environmental Protection Agency is cutting its R & D plans from \$153 million to \$149 million and, in the process, is reducing its solid waste disposal programme by \$24 million and its air pollution research by \$6 million.

Now that the shock of the budget has settled in, organised cries of pain are being heard from those affected. Stanford Medical School, which would lose \$3.3 million a year from the termination of NIH's training grants programme, has stated that it may be unable to fulfil commitments to 271 trainees in pre- and postdoctoral programmes, and that if the trainees and their money go, which is what the Nixon administration plans to accomplish over a three-year period, a good deal of faculty and supporting staff will have to go too. The result, in the modest appraisal of Paul Berg, chairman of Stanford's Department of Biochemistry, would be "the virtual dismantling of the foremost health sciences research programme in the world".

The biomedical research lobby being the most potent in all the sciences, it may be expected that a great counter-attack will be staged from Capitol Hill, where legislators customarily trample one another in efforts to champion "war" on this or that disease. But what they no longer have going for them are their old allies inside the NIH bureaucracy. The publication of the budget was preceded by the dismissal of the NIH director, Robert Q. Marston, who is yet to be replaced.



Sitting atop the department of Health, Education and Welfare, of which NIH is a part, is Nixon's shrewdest and most efficient budget cutter, Caspar Weinberger, who moved there from the directorship of the Office of Management and Budget. Congress may rant and rave, and perhaps the administration will yield a bit here and there if the pressure becomes intolerable, but the odds for a major reprieve are not good.

Normally, the budget documents emphasise the bright side of government relations with research and omit mention of any dissatisfaction with the performance of the R & D community. This year, however, there is an admonitory note which clearly reflects the administration's feeling that it has not been getting proper value from its investment. The new budget, it states, "balances support for programmes in areas of national importance—where research and development can make a contribution—with recognition that all programmes are not equally urgent, that the private sector has incentives to innovate, and that improved R & D management is needed".

Dan Greenberg

Venture

Passive electronics

The total sales of the British electronics industry amounted to £1500 million in 1971. The largest sector was telephones at £299 million. Then came computers (£231 million), consumer goods (£214 million), and passive electronic components (£210 million). The only other sector in this league was radar navigation and communication sets, at £180 million.

An "active" electronic component is one which amplifies an incoming signal. The first such device—the three electrode valve—upon which every branch of electronics is based was not developed until 1907. Surprisingly almost all the other ("passive") components were invented before 1900, starting with the Leyden jar in 1745—a huge plum-jam container covered with silver foil such as Thurbur's aunt might well have conceived as the obvious means to store electricity. Power transformers, relays, inductors, fuses, carbon-composite resistors, and the electrolytic capacitor were all 19th century developments. In 1900 the first self-healing metallised paper capacitor was announced. These have so thin a layer of metal on paper that if the insulation breaks down an intense current flows through the tiny flaw and vaporises the metal. Thus the flaw is self-healed.

Since 1967 the sales of UK passive component manufacturers have increased more than 50 per cent by value. The most important markets are those for capacitors, connectors, relays and resistors but the highest growth has been in sales of terminals, which have tripled and of ferrite parts and film circuits which are both six times larger than they were.

At first glance the component industry seems to have a fairly good export record with a positive balance of £17 million and exports of £50 million. But just over half these exports are gramophone turntables and the rest of the industry is far from happy with its performance. Many of the world's components come from the offshore manufacturing areas and British companies have been chided for not having leapt on the bandwagon of cheap labour and low taxes many years ago. It may well be that companies could have done better with such rapacious sport but they would not employ 124 000 Britons if they had (nor 4300 scientists and technologists).

There has been considerable progress in harmonising European standards for all types of electronic component in the past five years. BS 9000 has been pressed through despite immense apathy from potential users, and now offers a viable international alternative to the mil. spec. which is of American origin. But of course if imports don't have to meet BS 9000 it will just be a weight round the necks of British companies.

In an unusual but admirable piece of participative politics one British company wrote to Messrs Heath and Wilson pointing out that there is little point in having standards for reliability and safety if these do not apply to imported goods. In fact both letters appear to have been received sympathetically and it may be that our importers will presently have to pay for stringent tests just as their counterparts do in Sweden and France.

Making components is generally a clean, warm, airy job with glossy machinery or home-made contraptions of immense subtlety. It looks a pleasant job but the turnover rate for women is 5 per cent above the national average at about 52 per cent each year. For men the turnover rate is about half this figure.

The key question for anyone who is considering long-term investment in the

components industry is whether it will eventually shrink because of the advent of large-scale integrated circuits which do not need discrete components. Television sets account for three-quarters of the domestic electronics market. In 10 years time it seems almost certain that a tv set will be made of a few chips rather than hundreds of components. This however will be during years in which all other markets will grow and some such as toys, hand calculators, and cars are as yet only small users of passive components. I would hazard a fairly heavy bet that within 15 years there will be no standstill in the passive components business as a whole. One or two types of component may stagnate and decay, but any nimble manufacturer should have ample time to diversify.

A. F. Bulglin has been an outstanding family company for years. Pre-tax profits run steadily at one-third of turnover, which has risen 50 per cent since 1967. The company was included in the 10 best-managed electronics companies by the Financial Analysis Group and is in a very strong position. Dividends have increased continuously since 1954 and the shares look a good buy at 29p. This is a p-e ratio of only 17.4 which is rather less than the average for electronics companies as a whole.

A.B. Electronics with sales of £6 million is four times the size of Bulglin. Its original strength lay in components for the domestic equipment market. In recent years the products have been upgraded to suit more professional markets which are not so cyclic. The company is concentrating particularly on thick-film circuits and ceramic substrates. It was able to increase its profit on reduced turnover in the year ended mid-1972 and could do very well indeed with its interim figure to January 1973. The shares seem to merit a slightly higher price than 103p which puts them on a p-e of only 12.9.

Unitech is a third company that may well merit a higher share price. Turnover has increased fivefold since 1966 and the profits growth has been immense. The company is well established in a number of different markets, especially as a component distributor. It was the first distributor to introduce technical representation in the field for transistors and seems likely to give surprises in the next few years, most of them nice ones. Shares at 130p are on a p-e ratio of 20.4.

Tim Eiloart

Scientific gardening



F1 hybrids

Each year more and more F1 hybrids feature in the seed catalogues. All are claimed to be superior in performance, or in appearance, to older varieties. They are also more expensive than ordinary seeds. The story behind this development is fascinating, yet little or no effort has been made to put it across to the ordinary gardener.

The term "F1 hybrid" derives from the shorthand of geneticists. It denotes the first filial generation arising from the cross-fertilisation of two distinct races. Provided that both parents involved in this cross are true breeding, then the F1 hybrids, although differing from either parent, will all show constant characteristics. Suitable pure line stock is readily available since established plant varieties are extremely constant. All that remains for the hybridiser is to cross differing pairs of parents and then select the combination that gives the most desirable progeny. Repetition of this particular cross will always produce identical plants. The F1 hybrids themselves do not, however, breed true. Indeed, in the classical approach to plant breeding, they represent only the first stage in a lengthy process of repeated crossings, each followed by careful selection, which ultimately leads to the establishment of a new variety.

The use of F1 hybrids therefore makes it possible to introduce worthwhile new plants very much more quickly than can be done using the traditional approach. F1 hybrids, however, are valueless as seed producers and they can only be propagated by repeating the original cross. Consequently the hybridiser is the only source of fresh seed. This, in effect, gives him patent cover for the introduction. Benefits to the grower are that he is assured of consistent quality, together with the added bonus of hybrid vigour. The extra vigour of inter-varietal crosses has long been recognised. It is also accepted that much of this is lost in the course of the inbreeding necessary to produce a stable self-perpetuating variety.

A major problem for the raiser of F1 hybrid seed is the necessity to ensure the cross-pollination of the selected parents. Commonly this involves much skilled labour. To eliminate self-pollination, the stamens of the female parent must be removed before they mature. These emasculated flowers are then fertilised by hand with pollen from the male parent. In addition, the plants may need to be kept in an insect-free environment to prevent the possibility of pollination from other sources. With all these added difficulties it is not surprising that

F1 hybrid seed is more expensive than that of normal varieties.

In some instances, however, the control of cross-pollination is simplified by the availability of male sterile strains which can be used as the female parent. For instance there are apetaloid forms of marigolds which do not develop stamens. When these are crossed with normal flower types the progeny of the cross is always normal, since the hereditary character for petal formation is dominant.

In the UK, F1 hybrids were introduced in tomato growing about 15 years ago. In this highly competitive field, early cropping, uniformity of size, even ripening and resistance to disease are all important factors. These qualities are difficult to achieve using traditional breeding techniques. The first breakthrough was the introduction of the F1 hybrid, Eurocross, which was raised in Holland. Since then, this and other F1 hybrids have largely replaced the older established varieties in commercial horticulture. Several F1 hybrid tomatoes are now available to amateur gardeners.

Petunias were the first flowers available as F1 hybrids. Here the pioneering work was done in America where petunias are particularly popular. Since then the range of annual flower species available as F1 hybrids has gradually increased.

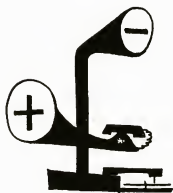
For obvious reasons, the development of F1 hybrids has been concentrated almost exclusively on species normally raised from seed. Geraniums and calceolarias, which are propagated by cuttings, are interesting exceptions to this general rule. Seeds of the F1 hybrids of these plants, when sown early in the year, produce quickly maturing plants which can compete with the traditional overwintered rooted cuttings. This new approach greatly reduces the demand for heated glasshouse space and so is attractive to both professional and amateur growers. One difficulty for the hybridiser is that growers may decide to capitalise on the quality and vigour of the F1 hybrids by subsequently using them as a source of cuttings. Indeed this is already happening with some hybrid geraniums.

Joe Stubbs

Out and about

What young Americans are doing

Thank God Hussain's piece on "Whatever happened to dolphins?" (New Scientist, 25 January, p 182) has caused a stir. Several people have asked me if any comparable work is going on here. Unfortunately I don't know but, hopefully, thanks to one or two organisations—and I'm not thinking of no-compromise anti-vivisectionists—we have reasonably well-developed consciences on these matters. And enough people ready to growl at and, if necessary, bite backsliders where it hurts most. I have yet to hear of any cruel, useless experiment in British schools and it may be that in



this aspect of ethics we are light years ahead of America.

In that continent some inexcusably damnable work by youngsters is proudly exhibited to the public at so-called Science Fairs. Notwithstanding rules circularised by a few bodies including the National Society for Medical Research, requiring that qualified adult supervisors must assume primary responsibility for all exhibits, the results show that the majority of science fair experiments on vertebrates hurt or kill the animals. My authority is a well-documented information report (vol 21, no 3) issued by the Animal Welfare Institute of New York.

For instance, at a show in Washington DC last year a youth showed off his attempts at performing surgical operations on pregnant guinea pigs. Part of the uterus of the donor animal was removed and 12 attempts were made to implant fertile eggs into the womb of other animals. The youth stated that before engaging in these activities he had never seen the internal organs of a guinea pig, nor had he ever had any surgical or anaesthetic technique demonstrated to him. His knowledge of anatomy was restricted to having once dissected a frog. He thought it "a big jump" to go straight into surgical operations on guinea pigs.

No one was with him when he operated. A guinea pig died and one can only assume the inadequacy of the anaesthetic in other operations which lasted over two hours. One operation, claimed as a major breakthrough in genetics, resulted in the recipient animal aborting a still-born, half-formed foetus pickled and on display. Despite the fact that this project was in flagrant violation of the rules, a point made clear to the organisers, it received a First Place award.

At an adjacent stand pads were placed over the eyes of a mouse and electric current was passed through the pads causing the animal to run around uncontrollably and go into clonic convulsions. Convulsions were produced in other animals by means of a drug. A total of 1000 animals were experimented on. The student said some animals had died but he couldn't remember how many. In another experiment a mouse was anaesthetised and castrated. The supervising teacher had never before performed this operation on this species but had castrated a rabbit. A single post-operative observation was made and consisted of placing the castrated animal with a normal mouse and watching them fight. No other data were collected; a prize was awarded.

These gladiatorial displays are by no means confined to Washington. Of some 600 horrific cases of this kind take these two from that fine old self-respecting state of Massachusetts: at a summer camp a youngster was "shown" by a medical student how to remove the ovaries from animals. On returning home she attempted this surgical operation alone and unaided in the kitchen. She was awarded third prize which qualified her to exhibit the project again at the science fair.

Lastly, two monkeys were obliged through lack of alternatives to drink salt water until they became very weak and refused to eat. The monkeys' blood pressure fell and the student concluded the salt had caused the damage. Then, for 51 days, one of these weak monkeys was fed on cadmium acetate, a substance which causes intense pain when eaten by humans and doubtlessly causes similar pain in monkeys. The resulting human disease is called "Itai-itai" in Japan, meaning "It hurts, it hurts". As a result of this treatment the monkey suffered persistent high blood pressure and permanent kidney damage. These demonstrations of well-established facts were conducted, presumably at the public's expense, solely for the purpose of providing the youngster with a competition project and spectators with something to gawp at.

John Hillaby

The week ahead

Friday (Tomorrow)

Arthur Schawlow is co-author of the first scientific paper on the laser. At the Royal Institution, London, tonight (9 pm), he talks about "Lasers: present and future".

Saturday

At 10.30 am, BSSRS starts a two-day conference on "Science for people" at the Notting Hill Ecumenical Centre, Denbigh Road, London W11. Most of the conference time will be given over to workshop discussions on topics such as safety in the construction industry; psychotherapy on the NHS; IQ, race and streaming in schools; and cable tv.

Sunday

The World About Us (BBC-2, 7.25 pm) today shows "the strongest programme the Natural History Unit in Bristol is offering this year", according to the new editor Mick Rhodes. It features Jane Goodall among nomadic wild hunting dogs in Africa, following a pack across the Serengeti Plains of Tanzania and piecing together the natural pattern of their lives.

Monday

If you don't already know, you soon will: it's Copernicus' 500th birthday. At 10.55 pm, you can hear the first of three anniversary broadcasts (Radio 3): a talk between Jerry Ravetz and Pawl Czartoryski, editor of the new Copernicus manuscript facsimile.

Tuesday

At Queen Mary College, London, L. G. Brookes, from the economic and programming branch of the UKAEA, delivers a lunchtime lecture (1.30 pm) on "The world energy future and its implications for Western Europe".

Thursday

And, as usual, there seems to be more happening today than in the rest of

the week put together. At 10 am, the Royal Society kicks off a two-day meeting on the structure and function of haemoglobin; for lunchtime culture-hunters there is the Royal Institution's science cinema (1 pm) with two Open University films, one of them on the environment, or, at University College London's botany lecture theatre (1.20 pm), there's A. L. Allan on "The role of satellites in geodetic surveying"; at 5.30 pm, Leeds SSRS will hear Dr S. R. Eyre talking on "Mankind vs civilisation" in the University's Rupert Beckett Lecture theatre; while, at 7.30 pm, in the Royal Scottish Museum, Edinburgh, Dr Tom Cottrell, principal of Sterling University, will talk about "Planning and building a university". For TV fans, Their World (BBC-2, 7.35 pm) looks at the parent-young relationship; the same theme reappears at 9.15 pm, when Patrick Moore's 86-year-old mother talks about her son's early interest in astronomy and cricket; at 9.25, Horizon repeats its programme on the importance of a sense of smell. For late night viewers, "Take another look" (BBC-1, 11.35 pm), offers "Meals with a difference", which includes film sequences of insect-eating plants and the activities of the tiger beetle larva parasite.

Martin Sherwood

Tantalizer

No 282 Buttons and bows

"Happy birthday, quins!" exclaimed Professor Plato, handing a parcel to each of his five daughters, "I want each of you to open her parcel without letting anyone else see."

When the girls had done this, he went on, "Three of you have received buttons and two of you have received bows. I shall now whisper to each of you privately what a different one of the others has got." He did so and then resumed, "No one can yet deduce the present of any third girl; so let me just mention that Cecily has buttons."

"I now know everyone's present," said Gertrude.

"So, then, do I," said Margaret.

The other two girls are Margaret and Rosalys (the Professor being a devotee of Dante Gabriel Rossetti, as erudite readers will have spotted). Who got buttons and who got bows?

Martin Hollis

Solution to Tantalizer No 281 Sweet and sour

Kipper, Garlic, Verbena, Snuff, Salt Volatile

10 points must be scored. The maximum possible is $1+3+2+3+2=11$. So in just one column one less than maximum is wanted. So it is Garlic in B (anything else drops 2). If Curry in D, then Egg in E and C gives someone 3 points. So snuff in D, not Egg in E, not Vinegar in E, not Camphor in C. Hence Verbena in C, Salt Volatile in E and Kipper in A.

Review

Inspiration in numbers

by Professor Ian Roxburgh

Mathematics in a changing world
by Michael Holt and D. T. E. Marjoram
Heinemann Educational Books, pp 294,
£2.80

How do mathematicians think, how do they create new mathematics? What use is their mathematics, indeed what is it? Mathematics in a Changing World asks the questions but not surprisingly it cannot answer them. Instead, it gives snippets of information, glancing views of that broad foundation of mathematics on which most of our advanced technological society rests, and a slightly longer glance at some of its applications.

The authors do not clearly separate numeracy from mathematics. They confuse the mathematics with the application of mathematical tools to problems new and old, yet there is still much here of interest to the practising mathematician as well as the general public.

The application of mathematics to a model of the functioning of the brain is interesting although not very informative; the discussion on economics is simple minded; the application to geo-

graphy is elementary; and the chapter on population in the year 2000 is trivial. Yet, despite the simplicity of the discussion on applications it is of value, for here is a source of stimulation. Maybe a successor to Maynard Keynes will read the economics section and understand the present economy—let us hope so!

But what really is mathematics if it is not its applications to these problems, in particular its applications to physical sciences where it has had such striking success? Messrs Holt and Marjoram try to answer this in their opening chapters on "The Mind of the Mathematician", "Thinking and Reasoning", and "The Unreasonableness of Logic", but in my opinion no answer emerges from their discussion. Is it a vehicle for expressing logical deductions from axiomatic statements as in say Euclidean geometry, is it a vehicle for expressing *a priori* knowledge of say the number system, or is it just a kind of international shorthand? These questions are not answered here but again the value of the book is that it may stimulate someone to ask the questions!

And how does the practising mathematician work, how does he create his ideas. The authors here lean to the "Eureka" hypothesis—that instantaneous flash of inspiration in which the all-important leap is made. Undoubtedly this seems to happen to many creative mathematicians. Poincaré recalls how he saw the light while getting on to a bus, Dirac when out walking, while Descartes had his inspirations in bed! But are these examples to be taken at face value? Mathematicians meet with other mathematicians, they talk, read and write mathematics. Ideas are picked up in many places, they rest in the mind, and suddenly are recalled, modified and a new discovery is produced. But how much of this is the property of one man rather than the whole community of scholars past and present? There are many examples in science of almost simultaneous creation. Bolyai in Hungary and Lobachevsky in Russia both discovered Non-Euclidean geometry; was this an accident or a consequence of the activity of mathematicians at the time and in the past? I can only think that the nearly coincident creation is a reaction to a social development of a branch of mathematics, a reflection of questions being asked by the community. One, two or maybe more people fuse together concepts developed by the group and produce the new idea that we call a flash of inspiration.

However, this hypothesis cannot explain the extraordinary mathematical geniuses such as Ramanujan, the Indian railway book clerk who was able to pro-

duce complex mathematical results out of his head without having contact with the society of practising mathematicians. Was he and others like him uncovering *a priori* knowledge?

As a book on mathematics and mathematicians, I think it is weak. The authors have gathered together tidbits from different sources and made a book. Yet I read it with interest. They may not understand how a mathematician works—but who does? They have confused mathematics with its application, but how easily are they separable? But they intrigue. They lay before the reader a wide range of applications of elementary mathematics to modern intercourse, they titillate one's interest in logic and philosophy, they stimulate the reader to learn more. Any book that does this is worth reading.

Ian Roxburgh is professor of pure and applied mathematics at Queen Mary College, London

The scope of medicine *The Lancet*, pp 64, 30p

Medicine is not really an occupation at all: it is a collection of about a dozen occupations, grouped together for convenience because they all start off with the same basic training. Because this basic training is long and carried out according to a traditional system of what is essentially an apprenticeship, it also includes an important ethical and behavioural component.

For an outsider it is not easy to understand. The relationship between a research virologist and a surgeon captain, between an ophthalmologist and a ministerial adviser at the Elephant and Castle, is tenuous to say the least. The scope of medicine is wide indeed, and to the sixth-former or student it may present an almost bewildering variety of options.

The *Lancet*, in a booklet commemorating its 150 years of continuous publication, has tried to give such aspiring students a simple guide to what a career in medicine really means at this point in time. The Scope of Medicine is short and pleasantly produced. The authors and editors have wisely decided that readability is all-important in a publication of this kind. They have resisted the temptation to pack in too much information and they have leavened the text with quotes from personal experience. In a short appendix they give suggestions for further reading which are pleasantly varied, extending from the Report of the Royal Commission on Medical Education at one end of the spectrum, to works by Richard Asher, Paul Ferris, and A. J. Cronin at the other. Richard Gordon is surprisingly omitted from the list, presumably on the grounds that everyone

the animal in its world

vol. one—Field Studies

NIKO TINBERGEN

Niko Tinbergen is, together with Konrad Lorenz, acknowledged as the founder of Ethology. This collection from his publications spans forty years of what have been called his "creative observation". These include articles on the behaviour of gulls; on homing, landmark preference and prey finding by the digger wasp, *Philanthus*; on the behaviour of the Grayling butterfly; on egg-shell removal by the Black-headed gull; on creatures living scattered as a defence against predators; and on food hoarding by foxes.

£6.35 Illustrated

George Allen & Unwin

has read him anyway.

The authors begin by tackling one of the widely held misconceptions of the "doctor as idealist", and the first paragraph, headed "What Sort of Person?" is an admirable short exposition of how most doctors feel about their profession. Interest in the work is the primary factor, with idealism as a valuable ancillary. A modern doctor, after all, may never see a patient. To demand a sense of personal vocation in entrants for medicine might well end in depopulating the laboratories and the public health services to the detriment of the Health Service.

The booklet goes on to describe a medical career both from an undergraduate and a postgraduate point of view. Perhaps inevitably, the description is a little superficial in parts. It gives no inkling of the real problems confronted by young doctors, who more often than not have to work with inadequate supervision in rundown and poorly equipped provincial hospitals. It paints no picture of a GP in an under-doctored mining village and makes no mention of the registrars who get stuck on the consultant ladder waiting for vacancies that never appear. It mentions doctor emigration without giving any explanation of the reasons for it.

It is, in fact, a view from the bridge rather than the engine-room. So long as the student bears that in mind, he can read it with profit.

John Rowan Wilson

Copernicus: de revolutionibus orbium coelestium

Limited facsimile edition in 1500 copies

Macmillan and Polish Scientific Publishers, £35 (£25 until 31 March 1973)

The appeal of Macmillan's facsimile edition of Copernicus's seminal book *De Revolutionibus* is to the collector. This first edition ever published in Britain marks the 500th anniversary of the Polish astronomer's birth which falls on 19 February this year. Like the *Principia* of Newton, to which the heliocentric theory of the universe ultimately led, it is written in Latin. Moreover, Copernicus's Renaissance hand is not particularly legible. There is no printed text included since that forms Volume 2 of the original Polish three-volume edition of all the astronomer's works. Macmillan's do not seem to be going to publish the other volumes, although they have hinted at a translation to appear at some unspecified date. Such notes as accompany the facsimile are to do with the manuscript itself—the "quires", the watermarks, the handwriting, the binding, and its history since Copernicus parted with it.

It is always hard to see just what the purpose such facsimiles serve, other than as an investment. The original appears to have been faithfully copied indeed, and no one should quarrel with the meticulous production of this fine edition. Only the binding with its poor portrait and indifferent lettering leaves something to be desired. But, unlike fine art books, there is no real aesthetic appeal in these pages. Certainly it is interesting

to see the diagrams Copernicus actually drew to make his Earth-shattering argument. It is intriguing to see the MS in process of formation, as it were, with passages deleted and scribbles in the margins. No doubt the historians have minutely scrutinised every one. But Copernicus, amateur painter though he was, did not intend his book to be a visual work of art; it is the *ideas* that have aesthetic appeal. And it was its intellectual content, marking the culmination of a life's diligent work, which made it so important. From a facsimile in largely unreadable Latin, alone, we cannot glean very much. As Rutherford once said: there are physicists, and there are stamp collectors. Although, in fairness, it is quite some stamp!

Peter Stubbs

Jeux et enjeux de la science

by Pierre Thuillier
Robert Laffont, pp 332, npg

The signs are that neither scientists nor those who pay them are very clear about how best science can be accommodated in the framework of society. It is evident that the debate on this subject goes well beyond what traditionally has been the realm of science. There are indications that scientists do want to get their say in it. But are they, on the whole, prepared for it?

Popular scientific magazines, such as New Scientist, have an obvious part to play in providing a platform for discussion on the impact of scientific results on the world at large. *Jeux et Enjeux de la Science* is a collection of 20 articles from two French popular scientific magazines: *Atomes* and *La Recherche* (the latter being the successor of the former). The author, Pierre Thuillier, is a philosopher by training and is now a lecturer in philosophy of science at Nanterre (Paris-X) University. His subtitle "Essays in Critical Epistemology" sounds rather grand but he aims his book at anyone with an interest in the sciences and their wider social and political implications.

The articles are wide ranging: some come within the bounds of "classical" philosophy of science (for example "How Theories Are Made"), a number of them are book reviews, and some treat politically relevant subjects such as the report on the 1968 Pugwash conference and a long interview with Milton Leitenberg, the documentalist of military involvement in science. What unifies the book is Thuillier's concern to give a balanced view of the attempts by scientists to look outside the boundaries of science and the extent to which they succeed in coming to grips with the social, political, philosophical and metaphysical implications of their disciplines. This is, of course, most apparent in the book reviews: Jacques Monod's celebrated *Chance and Necessity* does not escape some serious criticism, in particular for its highly emotional style. On the other hand, Francois Jacob, who had shared the Nobel Prize with Monod, receives much praise for his mature and well balanced views in *The Logic of the Living*. Others receive praise or criticism

**If you really
want to know
about
computing—
get your facts
right from the
National
Computing
Centre.
You need to
read NCC
Publications.
77 titles in the
current list.
Price
discounts for
NCC Members.
For free details
contact:**

**NCC
Publications
Quay House
Quay St.
Manchester
M3 3HU
NCC**
THE NATIONAL COMPUTING CENTRE LIMITED

according to how successful have been their excursions into extra-scientific territories.

Pierre Thuillier deserves praise for his thoughtful and careful treatment of his diverse subjects. He has avoided all temptations to be dogmatic. To scientists (and others) who wish to express opinions on the wider implications of science, his approach is clearly recommended. The book is well documented, sympathetically suggesting ways to explore the largely uncharted areas on the boundary between science and society. One warning though, it is in French!

Andre Balogh

World of wildlife

by Dr Felix Rodriguez de la Fuente;
English language version by John Gilbert
Orbis Publishing, 20p per part

To measure the impact of the mass-media on the armchair naturalists of today one need only consider the difficulties that faced any researcher, 100 years ago, who wanted to familiarise himself with the sight and sound of, for example, the world's ducks or antelopes, or even—to take a smaller group—the various kinds of flamingo. Denied the use of film, colour photograph or sound-recording, a 19th century student would have found a lifetime of travelling hardly sufficient to give him a detailed mastery of his subject. The popular education that Northcliffe pioneered and Reith continued may not have realised all its ambitions but among its achievements it can point to the well-informed young naturalists of the present generation, for whom field-guides, wildlife parks, animal films and recordings on television and radio, package safaris and specialised periodicals are normal everyday tools for finding out about our natural environment. Anyone who is still ignorant of the life-cycle of the salmon, the distribution of the white rhinoceros or the sound that curlews make, has only himself to blame!

Among recent innovations in this general field of popularised natural history, World of Wildlife merits recognition for the scale and quality of its aims. It is a part-work, issued in weekly instalments designed to be collected and bound in 10 substantial volumes when the whole work is completed. The publisher supplies binders as the series progresses, and the subscriber who stays the course (150 weeks) will have an impressive and encyclopaedic work of reference in a permanent form. To make the best use of it a detailed index will be essential: on this point the publisher could usefully give an assurance, if he has not already done so.

What is perhaps surprising is that the primary initiative for World of Wildlife was Spanish. The text is by Dr Rodriguez de la Fuente, who has also done much to popularise wild-life programmes on Spanish television, and he has been supported by a scientific staff which is largely or wholly Spanish. Nothing hitherto has emerged from Spain to challenge the publishing standards of the recognised European and American leaders in this field, which makes the appearance

of this beautifully produced work all the more welcome. The text has put its sights commendably high in relation to a popular audience; there are no cheap concessions in idea or vocabulary. The strongest emphasis is placed on ecological relationships, characteristic behaviour, evolution, systematic classification and distribution. The first three volumes, which are now complete, are devoted to Africa south of the Sahara (the "Ethiopian zone" of the zoogeographers) and they maintain a standard of illustration which is quite superb. In colour throughout, the abundant photographs are supplemented with distribution maps, zone-charts and other visual aids. Simply to turn the pages of the English edition is in itself a pleasure. The text reads well and has evidently been adapted with care. To split hairs on minor points would be out of place in a brief notice—what is far more important, in any case, is to stress that the general sweep and style of World of Wildlife is authoritative, responsible and unquestionably attractive.

Desmond Hawkins

Astronomical photography at the telescope

by Thomas Rackham
Faber & Faber, pp 280, £5.50

A metamorphosis is now taking place in amateur astronomy. Observers are moving away from purely visual work, such as drawing the surface features of planets and the like, into the realm of photographic astronomy. In my area, a group of amateurs are constructing a 30-cm reflecting telescope of advanced design with photography primarily in mind. Although the British Astronomical Association does not yet have a section devoted solely to photography, it is clear that many of its active members derive much pleasure from taking photographs of the heavens. In the United States, with its clearer skies and higher incomes, the amateurs have excelled for many years in producing pictures of nebulae and star clusters that rival those made by large professional observatories. Now that NASA space missions have superseded the work of ground-based astronomers for many lunar and planetary investigations, it is inevitable that the laymen will concentrate more on the photographic approach.

Dr Rackham provides an excellent and comprehensive text on how to get going in astronomical photography. The minimum requirements for obtaining good pictures of a variety of celestial objects are: a firmly mounted 15-cm reflecting telescope that can be driven and guided to follow the motion of the night-sky, a 35-mm reflex camera body, film, and a cupboard under the stairs for processing work. It is possible to do limited investigations with less apparatus: photographs of the constellations can be taken in colour with a 35-mm camera mounted on a tripod. (If any readers of New Scientist wish to attempt this, a 2-second exposure on ASA 64 at f/2 should give acceptable results.)

The introductory chapters of Astro-

nomical Photography at the Telescope provide a comprehensive guide to the basic instrumentation and accessories required for astronomical photography. This is followed by a central portion giving information on how to photograph the Sun, Moon and planets. Finally there are chapters on aspects of darkroom technique. This instructive book can be recommended without reservation to anyone who has a small telescope and wants to hook up a camera to it.

Simon Mitton

The origins of life

by Cyril Ponnamperuma
Thames & Hudson, pp 216, £2.25,
Paperback £1.25

Professor Ponnamperuma provides an entertaining account of topical ideas and of the scientific approach currently being used to answer the age-old question of how life began. It was scientific method in the 19th century that led to the downfall of the theory of spontaneous generation. It is ironic then that in the present concept of chemical evolution life arises from non-life, albeit on a vastly different time scale of millions of years. The evolution of the contemporary biosphere from simple molecules has been a gradual process. The development of this hypothesis is traced from the writings of Darwin, through Haldane's primordial broth to the laboratory experiments designed to demonstrate the formation of organic compounds from simple inorganic compounds. Professor Ponnamperuma argues that there is a continuity of life from atoms to the planets and man, and also that there may be many opportunities for life to exist in the universe.

The formation of organic molecules when primeval Earth conditions are simulated in laboratory experiments now supports the idea that organic molecules were first synthesised from simple inorganic molecules in the primeval Earth's atmosphere. Professor Ponnamperuma's own enthusiastic involvement in this work is obvious. Further experiments show that polymers of amino acids can also be formed under simulated conditions. It is unfortunate that the chapter discussing the fascinating problem of the highly specific stereochemistry of natural proteins is marred by errors and misconceptions.

The second half of The Origins of Life describes the information that is being gleaned from molecular fossils, lunar rocks and the organic matter in meteorites. Again the author's personal involvement in some of this work lends authority to these chapters. The excitement of examining lunar material for the first time is conveyed well to the reader, and there is discussion of the likelihood of life on other planets in the solar system, particularly Jupiter and Mars. Finally, Ponnamperuma deals with the possibility that some extraterrestrial forms of life have reached a stage of communication superior (or comparable) to our own. He does not ignore their intervention in worldly affairs, as depicted in many legends.

Although Ponnamperna biases his book towards the chemical aspects of the topic, he writes it in such a way that it does not require a great knowledge of chemistry. It is lavishly illustrated in colour and black and white, the text only occupying about half the total page area. I recommend this up-to-date attempt to answer the question of how life began, as general reading, especially for students of biology and theology.

Bryan Winchester

Two views

Futurismo 1909-1919

Exhibition of Italian Futurism
Royal Academy until 4 March

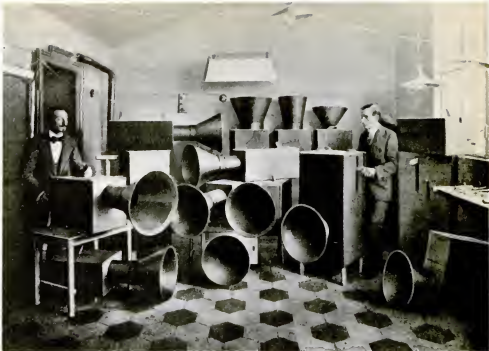
we want war we want speed we want force
we want no punctuation we want no
adjective we want no adverb we are a
social movement our music goes from f
to ff to f to f to f to f to f to f to f to f
lib and we want speed lines must be
banned as contours lines mark movement
and velocity areas show lines in motion
we use spectrum colours

we draw word pictures
and use anything
that hits
the

i
we pursue the dynamic approach of
cinematography and either paint several
successive frames we want speed on top
of each other or else open and close
the shutter on the same bit of film we
want machines

It all came true like Mein Kampf. The fragmentation of the painted image sneers from the shabby walls of the once royal Academy, and we are greeted by the conception of kinetic and almost op art. The conversion of multiple light exposures on one film is developed into a message by Balla's Rhythm of a Violinist with the many hands, more brilliant in inventiveness than his more famous but unexhibited Girl Walking Along a Balcony. The touching experimentation, which searches how to project in two dimensions not the stupid orthodox three-dimensional world which you think you see but the thrilling multi-planar universe of reality, this also is shown. It is shown to lead to Severini's Dancer. This master-piece integrates analysis and the jigsawed bits, which represent different points of view, result merely from the newly discovered principle of communication scanning. Seurat had used pointillism 25 years earlier to mix light by optical means. The futurists are past caring about light: they divide to blur the issue as if everything whizzed past with an angular velocity of 40 degrees per second or more. But one has to concede that, if there is experimentation at the start, at the end you find perfection.

The musty nostalgia of dog-eared manifestos left England cold. If we except vorticism, her response to the cis-alpine screams was nil. But now we know that, in spite of Caporetto and the debacle in the Western desert, the mothered racy racing under-sexed Italian



Not all the Futurists were artists. The RA exhibition also includes examples of Futurist poetry, Futurist theatre (including the idea of completely mechanical performances with no human characters), Futurist music (Luigi Russolo's noise machines in the 1920's—one of which is shown here—were the fore-runners of *musique concrete*), and Futurist architecture

male craves war. We learn also that the architectural horrors of Mussolini's era are rooted less in the Gothic polyoliths of Assisi's basilica than in the ruled out-pourings from Chiattoni's and Sant'Elia's drawing-boards. If Centre Point makes you feel small this exhibition tells you why. There is not a tree in sight and hardly a soul: human dwarfs appear in only one of these many monstrous sketches. Battersea power stations and endless buildings, regrettably not disappearing even at the vanishing points, provide concrete evidence for the foresight of these extra-ordinary seers.

The whole thing is merciless. Even Depiero's Marchesa Casati—a true blue in more senses than one—shows the Futurists' ruthlessness. The past shows up in the Modern Idol and the Study for Horizontal Volumes: Boccioni tried in vain to escape from the grip of Caravaggio's Gorgon and the grin of Leonardo's haggard cartoon. But otherwise the space-time continuum envelops future memories of Mondrian, of Braque, of Picasso, of Feininger, even of Paul Nash.

Three-dimensional geometry, curved Brownian movement tracks, and previously unused metals, even celluloid, invade Futurist sculpture. We have seen it all before and shall realise only afterwards that that past was the future of one that preceded it. As experimental evidence that a programme can be carried out with rigour and vigour and project its reverberations for more than half a very fast moving century, this exhibition has few parallels. I shudder at the thought that somewhere we are looking even now at an even gloomier programme—less articulate, of course, for the century is advanced—and that most of us are unaware that we are seeing it.

Robert Weale

Futurism, the movement which flourished in Italy in the years immediately before the First World War, is one of the sadder chapters of 20th century European art. Based on a highly romantic conception of the powers of science and technology, and glorifying sensations of speed, noise and mechanical action, Futurism was one of the first attempts to introduce an "aesthetic of technology". It emphasised that technology seemed to have a beauty of its own that need not be imported from other art-forms, and its later influence has ranged from the industrial design of the Bauhaus to modern kinetic sculpture. Yet Futurism itself failed when reality caught up with its fantasy; its life-blood was sucked by the carnage of the First World War, and the final death blow delivered by the rise of Italian fascism in the late 1920s.

The current exhibition at the Royal Academy of Arts is the largest collection of Futurist works to have appeared in Britain since an exhibition held in London in 1912, when the movement had only just reached maturity. The exhibition provides a valuable historical documentation of a crucial period in the development of the art/technology relationship. Inevitably, however, the formality of presentation and air of distant reverence makes it difficult to escape the feeling of looking at a carefully-embalanced corpse.

The importance of Futurism lies as much in the way it relates to the social and historical situation of Europe at the turn of the century as it does in its influence on later art movements. Caught in the turmoil of political and cultural upheaval, the Futurists turned to science as a haven of order from which a new romanticism might emerge. F. T. Marinetti, for example, in many ways the driving force behind the movement,

expressed this most clearly in his 1914 manifesto when he wrote: "From the chaos of the new contradictory sensibility born today is a new beauty, which we Futurists will substitute for the former one, and which I call geometric and mechanical splendour."

The best of the Futurist artists was Umberto Boccioni, whose main attempts were concerned with integrating the dynamics of movement into drawing, painting and sculpture. This is done, as for example in his paintings of cyclists and running horses, by simultaneously breaking down and distorting the image in the way it might be seen by a stationary observer (such as elongating the bicycle wheels), and holding it together around the apparent lines of force describing the movement. Ironically, one of Boccioni's best and last paintings depicts a line of lancers charging into battle (1915); he was killed in the First World War after a fall from a horse. Of the others, Giacomo Balla comes closest to capturing the feeling of speed in the stationary visual image. Particularly striking is his *Speeding Automobile* (1913), which attempts to show, according to the catalogue to the exhibition, "the lines of force of a high speed object cutting through space."

Ultimately, however, a movement that excludes the human element in art so completely in favour of the apparently limitless powers of science and technology was doomed to failure. To proclaim "Long live war, sole hygiene of the world!" or praise the excitement of "the nocturnal vibrations of arsenals... and factories suspended from the clouds by their strings of smoke" may provide a fascinating world of fantasy; set against the cold light of reality, its message can—and did—turn very sour very fast.

David Dickson

Exhibition

Faraday museum and laboratory

Royal Institution, London,
from 13 February

After two years of renovation and restoration, Michael Faraday's magnetic laboratory in the basement of London's Royal Institution is now on show to the public. Attached to it is a new museum on Faraday's life and work—in what used to be Sir Lawrence Bragg's X-ray laboratory (see "Faraday restored", by Dr Martin Sherwood, *New Scientist*, vol 49, p 556).

In the corridor leading to the museum is a display of pictures of modern power installations—a cogent reminder of how much the heavy electrical industry owes to the string-and-sealing wax apparatus that fill much of the museum itself. The museum is not restricted to Faraday's scientific work, although this is excellently covered, with sections devoted to electric machines, electromagnetism, electromagnetic induction, electro-chemistry, dielectrics, discharge in gases, organic chemistry, alloy steels, optical glass-making, and liquefaction of gases. In



Professor King at Faraday's work bench in his magnetic laboratory, once the Servants' Hall at the Royal Institution

addition, there are some of Faraday's personal belongings, pictures of the man at different stages of his life, and a display case of documents. The latter includes not only the book of notes which Faraday made and bound after attending four of Humphry Davy's lectures in 1812, but also the original text of Faraday's historical statement respecting electromagnetic induction; this statement, written to clear up accusations that he had plagiarised Wollaston is corrected in pencil by Wollaston himself.

Beyond the museum, protected by a glass wall, is the magnetic laboratory itself. The main laboratory of the Royal Institution used by Davy and Faraday no longer exists; the magnetic laboratory was created by Faraday out of the original Servants' Hall at 21 Albemarle Street (and still bears this designation on its door). In this laboratory stand Faraday's great electromagnet, and a host of other pieces of apparatus, chemical specimens and Victorian scientific glassware. Together, the museum and laboratory provide a dramatic insight into the work and life of one of Britain's greatest scientists, and it is a tribute to the Royal Institution that it has managed to produce this fine, permanent exhibition. To enlarge on the museum's display, the Royal Institution has also just published Michael Faraday of the Royal Institution—an illustrated booklet about Faraday's life and work, by Professor Ronald King, director of the museum project.

The museum, at present, is open to the public between 1 and 4 pm on Tuesdays and Thursdays; in the summer, it is hoped to open it every day. Schools and other special parties may see the museum at any time by prior arrangement.

Martin Sherwood

TV

Science is dead, long live science

Horizon BBC 2, 15 February 2125h, and 18 February 1720h

It's not often that television scoops the other media in science reporting. Horizon pulls off this rare feat in *Science is Dead, Long Live Science*. The programme starts off slowly, covering sadly familiar ground in order to convince us that science (American establishment science in particular) is dead. The arguments advanced are more likely to reinforce the conviction that it is horribly alive.

A succession of disillusioned American scientists express their varying complaints about their profession "operating in a moral vacuum and out of touch with the people". These personal histories are interspersed with accounts of the monstrously disproportionate dollar expenditure on defence research as compared with more directly beneficial research. Napalm and the electronic battlefield also get a look in. Gofman and Tamplin, surprisingly, don't.

The programme lives up as it leaves these preliminaries and looks at the widely differing responses that dissenting American scientists have made to their situation. The picture it gives is one of confused revulsion, revolt, redirection and, in some cases, retreat.

The big scoop is the extensive hunk of film (about 25 minutes) devoted to the activities of a group of biologists and others who call themselves the New Alchemy Institute. They explain their overall goal as the development of "low cost ways in which people could gain greater control of their own lives", and concentrate on the use of biological systems to achieve their aim. They have short-circuited the problem of financing some of their research by appealing to the readers of a large circulation organic gardening and farming magazine to conduct research in cooperation with them. Interested readers are asked to set up in their back gardens a particular freshwater fish farm under a geodesic greenhouse. The pond contains a balanced ecosystem of molluscs, plankton, higher plants, insects and fish, and is surprisingly productive per unit area compared with commercial freshwater fish farms.

Aside from their interest in small-scale food production, they are developing biological filters for water purification and are experimenting with windmills. These attempts to apply science to produce technologies which make sense in terms of society, a battered environment and diminishing resources are encouraging after the funeral pall which hangs over the first half of the programme.

It is sad that so little is happening in Britain that the programme could not be made here. Although our scientific establishment differs little from its American big-brother, its minions have yet to develop as coherent, or even as noisy, a critique—let alone to engage in activities similar to those of the New Alchemy Institute. It is this very inactivity which makes *Science is Dead, Long Live Science* so important.

Colin Moorcraft

Letters

Ordnance Survey

Sir,—I am very disturbed by your article (Technology Review, 8 February, p 306) on the future of the Ordnance Survey. Its maps, at all scales, are of importance to many parts of society, from town planners to mountaineers. I am interested in the countryside and would never contemplate travelling without an Ordnance Survey map as they contain so much information about the locality which is of interest to me.

It seems a small price to pay to keep the present system going compared with the inestimable loss caused by a cutback in the quality. Many foreigners often comment on the high quality of our maps and say how they wish they had maps like that back home. Life is not just a matter of hard economics—so let's keep the Ordnance Survey as it is.

Richard Deane

University of Manchester
Owens Park
Tower 912
293 Wilmslow Road
Fallowfield
Manchester 14

Sir,—I am alarmed at your item on the Ordnance Survey—there is also an inaccuracy when you say that the OS is "primarily a military set-up." it is no such thing and to the best of my know-

ledge and belief has never been so in the 180-odd years of its existence. Perhaps you have been misled by the fact that nearly all the senior posts are occupied by officers of the Royal Engineers—this is little more than a kind of out-dated prerequisite rooted in history and its origins.

My alarm is caused by the government report you refer to: evidently they are wholly unaware of the existence of a Treasury-instigated report of 1938, resulting from an inquiry presided over by the then Master of the Rolls, a gifted and intelligent judge. The Treasury got the idea that the OS was a waste of public money: the report showed so conclusively that by understaffing the OS, the Treasury were causing the country as a whole to pay out far more than the OS cost, on making the maps it needed, owing to great out-of-dateness of the existing maps, due again to Treasury cuts at various times, that it was decided not only to double the strength of the OS permanently but also to take on large extra "temporary" staff, for 10 years, to enable the OS to catch up. A year later the Second World War began, so although the main principles of this report had been accepted and many implemented, it was not till after the war that the OS was able to make progress with "catching-up:" it still has a long way to go. Let the

1938 report be unearthed and studied: its arguments were accepted by the Treasury then, and that should be enough for anyone now.

The Lantern
Mullion
nr Helston, Cornwall

Longevity in Vilcabamba

Sir,—Dr David Davies says ("A Shangri-la in Ecuador", 1 February, p 236) that the evidence of age drawn from baptismal certificates is difficult to doubt, but a genealogist would normally suspect a "lost" generation when confronted with claims of such amazing longevity. As baptismal certificates were issued, one assumes that church registers of baptisms, marriages and burials exist for Vilcabamba and for the villages and towns in the neighbouring areas; one wonders whether any of the workers concerned with this valley have had the opportunity of applying the family reconstruction techniques of population historians (as described in An Introduction to English Historical Demography ed E. A. Wrigley) to the parish registers of the region, and whether the results support the claims of the oldest inhabitants of Vilcabamba.

Beryl Crawley
189 Handside Lane
Welwyn Garden City
Herts

ADVERTISEMENT

CARE ABOUT NATIONAL PARKS?

A Bill is quietly filtering through Parliament which will set a dangerous precedent for heavy industry within our National Parks. The North Wales Hydro Electric Power Bill intends to set up the largest pumped storage scheme in Europe at Llanberis within 3 miles of the summit of Snowdon—the focal point of the Snowdonia National Park.

This Bill would establish—a 130ft. dam at Marchlyn Mawr under the Pillar of Eildir, Snowdonia's only isolated rock peak—dams at each end of Llyn Peris at the foot of Llanberis Pass, making a mud bath of that lake and obstructing the views of the lakes from the Snowdon Pyg Track, from the Pass and below Dolbadarn Castle—the classic scene which has been painted by many of our finest artists including Cox, Turner, Cotman, Linnell, Varley and Wilson.

Other provisions of the Bill extend into the Ogwen valley—Ffynon Llugwy and Llyn Ogwen to become water supply reservoirs with associated aqueducts/pipelines along the valley (to compensate for the loss of Marchlyn as a water supply). Seven years of heavy construction, traffic and noise within a National Park—road building, closure of footpaths and rights of way, diversions of streams and rivers via tunnels and aqueducts. And afterwards? A permanently ruined environment—more unemployment than before (only 40 permanent jobs) and more local pressure for another such scheme as a 'solution'. Having set a precedent, it could then be the turn of Dolwyddelan and suitable sites in our other National Parks.

What is the purpose of this project? According to the C.E.G.B., to provide for sudden peak loads such as "at the end of popular television programmes when millions simultaneously switch on their electric kettles". Have they got their priorities right?

We don't think so. If you don't either then help us by writing to your M.P. NOW! Tell your friends to write also, or fill in the coupon below and send that. Apathy could lose you your National Parks.

Donations should be sent to: **The North Wales (H.E.) Protection Committee, 40 Hamilton Square, Birkenhead, Cheshire L41 5BA.**

CUT HERE

To.....

M.P. for The House of Commons, London, S.W.1.

As one of your constituents I ask you to do all you can to oppose the North Wales Hydro Electric Power Bill which seeks powers to construct a pumped storage scheme in the Llanberis area of the Snowdonia National Park.

Name:

Address:

Signed:

Date:

Parapsychology

Sir,—Concerning parapsychology: it seems to me inevitable that one day some one will ask, "How do we investigate the scientific method?" This question is inevitable, I think, because of the fifth suggestion put forward by Dr Christopher Evans in his report (25 January, p 209); namely that "a theoretical framework should be sought, as little progress would be made without one". H. E. Huntley, (Letters, 1 February, p 267) suggests that philosophers strolling in the Elysian fields will come up with such a framework. I think, not to be frivolous, that this is on the right track. Here are a few questions which I feel the scientific mind has to answer in its own inimitable way: How do we discover how the scientific method works? Can we use the "scientific" to find out? Assuming that the scientific method will be the last discovery of the scientific method, is there any point at all in pursuing the topic right now? Or is this the most important pursuit of all? If the ontological foundations of science are beginning to tremble, shouldn't we perhaps look at our consciences rather than our slide-rules?

I have another very basic point to make: it is insane to cut open a dog to investigate its nervous system, to find out, for instance, what is happening when it sniffs meat. Any sane human being with a feeling heart inside his ribcage knows perfectly well what is happening. He knows by sympathetic understanding. Any fool can have a heart of stone; but it takes a true scientist to have a thinking heart. What is going on when a pet dog licks a new baby, or is jealous of it. There are, I would have thought it was obvious, other ways to reliable knowledge than the route through the laboratory. What many feel and know about torture, as expressed in recent *New Scientist* editorials, is a case in point. Are the phenomena of parapsychology really so strange when held in this light? One might know how ESP works, for instance, simply by sympathetic understanding.

To feel certain of something in one's heart I would submit—now test this out if you are a scientist—is to need no

further proof. If there is anything, preferably living, in this world that you love, then let that which you love do something which delights it, and consider your feelings. What need do you have for proof as to how it works? I refer those who like a sound philosophical background to Wittgenstein: "the how is not the mystical but the that".

One knows how a dog's nervous system works in many instances because one can feel how it works. It is ludicrous to expect us all to feel in an identical manner about a single dog. Therefore no objective corroboration is necessary. I believe that objective corroboration of the information contained in the parapsychology files may well be, quite simply, unnecessary.

Sebastian Barker

The Old Bakehouse
Church Street
Reepham, Norfolk

Sir,—Reading the result of the investigation on parapsychology I observed that a most important aspect of this matter has not been taken in consideration.

The point is that not a single one of mankind's problems can possibly firmly be solved by this subjective and wasteful application of brain capacity. Even if some degree of relevance could be made acceptable by a mass of experiments and statistical work, there would not be the slightest possibility of applying the thing with more result and reliability than any wishful dreaming or talented guesswork.

Man's capacity and need for objective judgement which should distinguish him from the other creatures, is apparently still in a very immature state of development. The conclusion of the survey is sad, but it is important that it should be understood.

B. J. Helders

Gortelsweg 45
Vaassen
Netherlands

Nobelists, too

Sir,—Dr Herbert Eisner's conclusions ("University of the FRS", 25 January, p

197) about the productivity of British universities are supported by similar figures for Nobel prizewinners in science:

	FRS (1971)	(1972)	(1901-72)
		Nobel Prize	Nobel Prize
Cambridge	214 (38%)	12 (55%)	19 (44%)
Oxford	67 (12%)	2 (9%)	3 (7%)
London	145 (26%)	2 (9%)	5 (12%)
Others	139 (25%)	6 (27%)	16 (37%)
	565	22	43

Source: Who's Who; Dictionary of National Biography.

The first column is a summary of Dr Eisner's figures and shows the university of origin of Fellows of the Royal Society. It is to be compared with column two, origins of living British Nobel Laureates other than those with a non-UK first degree. The numbers involved are smaller but the correspondence is clear. That the position has changed little over the years is shown by column three, for all British prizewinners.

J. R. Johnstone

Physiological Laboratory
Cambridge

Unfair to judges

Sir,—Your contributor Donald Gould's jolly swipe at the judges (Forum, 8 February, p 320) is unfair.

Without showing that the Sunday Times article was not, or was unlikely to be prejudicial to the fairness of the proceedings, he hasn't begun to make out a case against them.

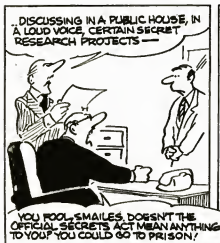
As regards the Nasty Tales trial, to pretend a verdict is scientific evidence of anything other than the opinions of the jurors of the case is laughable. Dr Gould (and I) may think that the judgement in the matter of costs was unjust but that doesn't qualify the judge for entry into the Non Scientist of the Year stakes. There are many potential entrants who show much better form than that and I bet some of them think of themselves as scientists.

Christopher Ironside

22 Abingdon Villas
London, W8

Grimbledon Down

Bill Tidy



Haggis-bashing

Sir,—For someone living on the other side of the Atlantic Patrick Ryan's haggis research strikes a familiar note (Feedback, 25 February, p 203). Ethnic humour has been around for a long time and probably all of us have succumbed to it at sometime, provided, of course, that the joke is not on us.

It is always hard to be open-minded to cultures different from our own. To see the consequences of what to us is just good fun requires an insight free from national stereotypes. Perhaps the English would have less trouble around their borders were they not so fond of lampooning their neighbours.

One stereotype of an Englishman is of someone who is pompous and ineffectual. Unfortunately Mr Ryan's contribution does very little to destroy this image. Think about this while you are out foxhunting this week-end.

Graeme Wilson

Route 13
Box 541
Birmingham
Alabama 35243
USA

Pollution solution?

Sir,—The only solution to the air pollution of Los Angeles ("Los Angeles heads for the crunch", 8 February, p 290) is not necessarily to reduce vehicle miles

travelled. If Angelenos drove cars giving 35-40 mpg instead of 8-10 mpg that alone would reduce emissions by the required order of magnitude all other things being equal. Spin off benefits would include much lower fuel bills and easier parking.

T. D. Bearson

27 Montbelle Road
London, SE9

Word wanted

Sir,—We have isotherms and isobars, but I have been unable to discover a word for a line or surface joining points of equal chemical concentration, although these arise in many diverse fields (diffusion, flame propagation and pollutant dispersal for example). Do your readers know of such a word, or if not, can they suggest a suitable neologism?

K. G. Doyle

The University of
Aston in Birmingham
Department of Chemical
Engineering
Gosta Green
Birmingham, B4 7ET

Sugar in tobacco

Sir,—Monitor reviewed (1 February, p 230) the mixed up nature of the evidence relating to the sugar content of air and flue cured tobacco and their supposed killer effect on smokers.

The little known fact that cigarette manufacturers in the USA are the second largest consumers of sugar may add quite a deal of confusion to the evidence. Air-cured tobacco is unacceptable in cigarettes until it has been dosed with appreciable quantities of sugar to modify the rawness of the smoke. The fact that such large quantities of sugar were used to treat air-cured tobacco for making into cigarettes was unknown until the Sugar Industries Association of the USA published the consumption figures circa 1950. Most cigarette manufacturers are reticent about the additives that are employed in cigarette manufacture. The fact that only the canning industry uses more sugar than the cigarette manufacturing industry in the USA must have some significance in this intricate problem.

Rees Davies

Dan-y-Coed
Portskewett
Newport, Mon

Correction

We regret that Dr Kenneth Bisset's article on the possible existence of a nuclear membrane in bacteria (8 February) contains a small error at the bottom of page 297. This passage should read "derived from an ancestral semi-permeable membrane, and the semi-permeable, multi-purpose membrane from an ancestral nuclear membrane".—Editor

CLASSIFIED ADVERTISEMENTS

LINE RATE 65p per line INCH RATE £7.80 per single column inch (25mm)

Advertisements received first post Monday will be published the following Thursday
If proofs are required; copy should be sent 8 days prior to publication date

Advertisements should be addressed to

Classified Advertisement Manager
NEW SCIENTIST

128 Long Acre, London, WC2E 9QH.
Tel: 01-836 2468 Telex: 27253

APPOINTMENTS AND SITUATIONS VACANT

UNIVERSITY OF BIRMINGHAM

Centre for Russian and East European Studies
Research, Development and Innovation in the USSR
RE-ADVERTISEMENT FOR RESEARCH ASSOCIATESHIP

Applications are invited for the post of RESEARCH ASSOCIATE in connection with this project, which is supported by the Social Science Research Council. An accurate reading knowledge of Russian and good background knowledge of the Soviet economy and/or Soviet Science and technology are essential. This is a two-year appointment tenable from 1 October, 1973. Applications for part-time appointment will also be considered.

Salary: £1419-£1626 p.a. + FSSU. Further particulars from the Assistant Registrar (RS), University of Birmingham, P.O. Box 363, Birmingham, B15 2TT, to whom applications (five copies) including names of three referees, should be sent by 6 March, 1973. Please quote reference RNS.

City of Leicester Polytechnic

require

Materials Scientist

in the

School of Architecture

to teach materials science within proposed C.N.A.A. degree course.

Salary

£3,131 - £3,495 (bar) - £3,768 per annum.

Apply for further particulars and application form to: Chief Administrative Officer (Dept. Est.), City of Leicester Polytechnic, P.O. Box 143, Leicester, LE1 9BH.

UNIVERSITY OF NAIROBI-KENYA

Applications are invited for the following posts:

Faculty of Agriculture
SENIOR LECTURER in HORTICULTURE in Department of Crop Production. Applicants should have a B.Sc. in Horticulture, Agriculture or Botany and a postgraduate degree in Horticulture and/or considerable experience in horticultural practice and research. Experience in horticultural education at University level will be an advantage.

Salary scale: K£2,256-K£3,636 p.a. (K£1 = £1.19 sterling). The British Government may supplement salaries by KSh 500 (sterling) for married appointees or KSh 500 (sterling) for single appointees (normally free of all tax) and provide children's education allowances and holiday visit passages. F.S.S.U. Family passages; various allowances. Detailed applications (2 copies), including a curriculum vitae and naming 3 referees, should be forwarded by airmail, not later than 21 March 1973 to the Registrar, University of Nairobi, P.O. Box 30197, Nairobi, Kenya. Applicants resident in U.K. should also send 1 copy to Inter-University Council, 90/91 Tottenham Court Road, London, W1P 0DT. Further particulars of these appointments may be obtained from either address.

Research Chemists

Our expanding Research Department has now moved into the newly completed laboratories on our Welwyn Garden City site and we are seeking additional organic chemists to participate in some interesting and important pharmaceutical research. Working together with biochemists and pharmacologists in project groups, they will be engaged in research in three main areas of interest, namely, cardiovascular and anti-inflammatory studies and chemotherapy.

Vacancies which are immediately available at different levels are for those with either A level chemistry, HNC, GRIC, B.Sc. in chemistry or their equivalents. Some experience in a chemical research laboratory, preferably in the pharmaceutical industry, would be a distinct advantage but is not essential.

Roche Products Limited is part of one of the largest and most successful pharmaceutical companies in the world and is itself one of the leaders in the industry in the U.K. Working conditions in our new laboratories are excellent and the conditions of service, including some valuable fringe benefits, are good.

Applications in writing, quoting reference RCG/T, should be addressed to Dr. A. R. Taylor, Senior Welwyn Personnel Officer.



Roche Products Limited
Welwyn Garden City Hertfordshire

PRODUCT REGISTRATION

A vacancy has arisen within the Product Registration Department for a young science graduate, H.N.D., H.N.C., or similarly qualified person to join the Head Office of a leading Pharmaceutical Company. The successful applicant will join a small team who are involved in the registration of products mainly in overseas countries. The work entails the preparation of submissions to Government Health Authorities and necessitates close liaison with our production, research and export departments. This position offers an excellent opportunity for administrative training in a scientific field.

Typing experience would be an advantage.

Applications will be treated in confidence and should be addressed to:

**Manager,
Registration Department
E. R. Squibb and Sons Ltd.,
Regal House, London Road,
Twickenham, Middlesex**

LUNAR RESEARCH ASSISTANT

Applications are invited for an S.R.C. Postdoctoral Research Assistant to work on carbon chemistry of lunar samples. Experience in the chemistry and physics of surfaces, heterogeneous catalysis or gas analysis advantageous. The appointment is available immediately for two years with the salary in the range £1,764 to £2,079, based on experience, plus PSSU. Applications, in writing with a curriculum vitae and the names of two referees, should be sent to Dr. G. Eglington, Organic Geochemistry Unit, School of Chemistry, The University, Bristol BS8 1TS.

Technicians

Our extensive laboratories in Blackfriars, London, S.E.1 have vacancies for all grades of Technical Staff in their Chemistry and Packaging Departments. People who have experience in these fields, are interested in Food Technology and have a minimum of 'O' level qualifications up to HNC, should apply for these interesting and progressive positions. Day release for agreed courses will be arranged for the right applicants.

We work a 5 day week—9.00 a.m. to 5.10 p.m. Monday to Thursday & 9.00 a.m. to 5.00 p.m. on Friday. There is an excellent subsidised staff restaurant, sports and social facilities and a contributory pension scheme.

Telephone or write for an application form to:
Miss P. Loveday, Headquarters Personnel,
J. Sainsbury Ltd., Stamford House, Stamford
Street, London, S.E.1 (01-928-3355 ext. 2187).
Please quote Ref. T/NS.

SAINSBURY'S

ANALYTICAL CHEMIST

The position calls for a good class honours graduate in chemistry, preferably analytical organic chemistry, aged 25-30, accustomed to working independently and taking responsibility. Applicants, qualified to H.N.C. and of exceptional ability and experience will be considered.

The work involves both conventional analysis (mainly carbohydrates) and specialized instrumental analysis including all forms of chromatography, polarimetry, atomic absorption spectroscopy and automatic analysis. A certain amount of routine analysis will be interspersed with some developmental work on new methods and techniques as required by various research projects. Non-contributory pension scheme, staff canteen and very good general conditions. Salary commensurate with age and qualifications.

Applications with brief particulars to:

**The Director of Research
Group R. & D.
Philip Lyle Memorial Research Laboratory
University of Reading
P.O. Box 68
Reading, Berks., RG6 2BX**

AHMADU BELLO UNIVERSITY - NIGERIA

Applications are invited for the following posts in Institute of Agricultural Research:-

Research Fellow in Agricultural Engineering

In Department of Agricultural Economics. Applicants must possess a good honours and masters degree in Agricultural Engineering with special emphasis towards the applications of engineering principles to tillage equipment studies. A Ph.D. is desirable but not essential. Two or more years experience in the practical application of engineering principles to agriculture would be desirable. Appointee would be expected to organise and conduct research involving the development or modification of equipment for systems of tillage and weed control appropriate to Nigerian conditions. This may include studies on minimum tillage, zero tillage, use of herbicides and other types of tillage associated with soil and water conservation practices.

Virologist in Department of Crop Protection

Candidate must hold a degree with specialisation in Agricultural Virology. Post-graduate research experience in this field, preferably in the tropics would be an advantage. Appointee, who would be offered appointment at Assistant Research Fellow, Research Fellow or Senior Research Fellow level depending on qualifications and experience, will assist in the development of a virology unit with the present plant pathology section of the Institute. He will also be expected to assume duties in the Faculty of Agriculture.

(a) Senior or Principal Research Fellow and (b) Research Fellow (Cotton Breeding) in Department of Plant Science

Appointee for (a) would be in charge of a 5 men team breeding sorghum maize penultimate millets and wheat for the seven areas of Nigeria. He will be personally responsible for continuing the current sorghum breeding programme which is based at Samaru, as well as co-operating on behalf of the Institute with international agencies. Substantial tropical experience in cereal plant breeding is essential. For (b) candidate must possess at least a good honours degree in Biological Sciences or Agriculture, preferably with some specialisation in genetics, and several years postgraduate experience in plant breeding or genetics. Tropical experience would be desirable. Appointee would be expected to conduct research, in co-operation with other members of a team, aimed primarily at the development of improved varieties of cotton for the Northern States of Nigeria.

Salary scales: Principal Research Fellow N6,100 p.a. Senior Research Fellow N5,030-N5,750 p.a. Research Fellow N2,760-N4,830 p.a. Assistant Research Fellow N2,140-N2,650 p.a. The British Government may supplement salaries of Senior or Principal Research Fellow and Virologist in range £700-£1,150 p.a. (sterling) for married appointees or £170-£260 p.a. (sterling) for single appointees (normally free of all tax) and provide children's education allowances and holiday visit passages. This supplementation is unlikely to be applied to the other appointees. Family passages; various allowances; superannuation scheme; biennial overseas leave. Detailed applications (2 copies), including a curriculum vitae and naming 3 referees, should be forwarded by airmail, not later than 16 March, 1973 to the Registrar, Ahmadu Bello University, Zaria, Nigeria. Applicants resident in U.K. should also send 1 copy to Inter-University Council, 90/91 Tottenham Court Road, London, W1P 0DT. Further particulars of these appointments may be obtained from either address.

INFORMATION SCIENTIST/ ABSTRACTOR

Young science graduate required for abstracting and some information and patent work. The position calls for a graduate in chemistry with a flair for writing and a working knowledge of German, Spanish or French. Some experience in abstracting would be an advantage.

Non-contributory pension scheme, staff canteen and very good general conditions. Salary commensurate with age and qualifications.

Applications with brief particulars to:

The Director of Research, Group R & D,
Philip Lyle Memorial Research Laboratory,
University of Reading,
P.O. Box 68, Reading, Berks., RG6 2BX.

Biochemist to develop important project.

We are looking for someone fairly young, who has a degree in biochemistry and a couple of years' experience in industry. He will be looking to apply his specialist knowledge in a broader field with the intention of one day moving into a management position.

We are a multi-million dollar organisation with interests in food products, cosmetics and proprietary medicines. There are manufacturing facilities in four European countries and sales outlets in more than 60 nations throughout the world. Our need is to expand an existing information service into a field which it has never before covered and provide a valuable contribution to this important group.

The successful applicant will be responsible for setting up and running an information processing, dissemination and retrieval system for HQ and line management at the various locations.

He will be concerned with raw materials, ingredients, hygiene, legal and medical aspects of the work throughout the group. A considerable amount of travel will be necessary, especially in the early stages of the project.

Opportunities exist to expand his role into management or research with the growth of the group's activities. We will pay an attractive salary and will help with relocation.

Please write to:

ITT Biochemist, Malcolm Kennedy,
36 Howland Street, London W1P 6BD.

ITT

Antarctic Expedition

Scientific Staff

(male)

- A. BIOLOGISTS** **BOTANISTS**
PHYSICISTS **GEOLOGISTS**
 For Glaciology
TERRESTRIAL GEOPHYSICISTS
- B. OBSERVATORY PHYSICISTS**
ELECTRONIC ENGINEERS } for
PHYSICISTS } Ionospheric work
ASSISTANT BIOLOGISTS
- C. TOPOGRAPHICAL SURVEYOR**
- D. METEOROLOGICAL OBSERVERS**
BIOLOGICAL TECHNICIANS

Qualifications: (A) Upper Second Class Honours degree or better. (B) Lower Honours degree or ordinary degree with experience or better. (C) Qualified Surveyor or Honours Civil Engineering with experience. (D) Appropriate experience and qualifications, Meteorological Observer, minimum 'A' levels maths and physics.

Training is given in all disciplines as required.

Research Scientists are encouraged to use their field data to attain higher qualifications on return to U.K.

Most scientists are required to work for 2½ years in Antarctica but some may be required to work only during Antarctic summers returning to U.K. to work in the laboratory between. Following this, Research Scientists are required to publish their work which involves up to two years working in the U.K. on return from Antarctica; other scientists work for shorter spells.

Life is interesting, organised on expedition lines, varied with scope for outdoor activities. Candidates must be physically fit, preferably single, aged 21-30, prepared to work in a team or individually without supervision, and be capable of improvisation.

Group A—Salary (incremental) from £1676, others from about £1500 (incremental) both according to qualifications and experience. Free polar clothing provided, free messing aboard ship and in Antarctica, low income tax.

Candidates will be required to commence work in July or August and will sail for Antarctica October/November. Selection interviews will be held between April and July. Closing date for applications 16th March, 1973.

Apply:— E.M.P., Salmon, British Antarctic Survey, 30 Gillingham Street, London, SW1V 1HY. Tel: 01-834 3687.

Please quote: AE/SS/NS.

BEDFORDSHIRE
EDUCATION COMMITTEE

QUALIFIED LABORATORY TECHNICIAN required at Stratton School, Biggleswade, Beds. 38 hours each week. For suitably qualified and experienced person, salary within scale £1,145 to £1,530 per annum.

Applicants should possess the City & Guilds Science Laboratory Technician's Certificate or an appropriate equivalent qualification for which an additional £42 per annum above the scale salary will be paid. Further payment of £30 per annum for possession of Advanced Certificate or equivalent alternative qualification.

Applications will also be considered from persons not possessing the above qualifications and for whom a lower scale of salary would be applicable.

Please apply by letter to the Headmaster, Mr H. R. M. Blayney, M.A., at the school, stating age, qualifications, experience and giving the names of two referees.

UNIVERSITY OF SURREY

Department of Biological Sciences and the Audio-visual Aids Unit

PART-TIME RESEARCH OFFICER

Applications are invited from Officers scale, on a pro-rata basis, with a qualification in the Biological Sciences and/or Education, for appointment to a part-time post of Research Officer (15 hours per week) to assist in a project to develop the use of television teaching methods in laboratory classes in Physiology. The salary will be on the Research Officer scale, on a pro-rata basis, which for 15 hours per week amounts to £385 per annum. Further particulars and application forms can be obtained from the Assistant Secretary (Personnel), University of Surrey, Guildford, Surrey, Tel: Guildford 71281, Ext. 452, and to whom they should be returned by 28 February, 1973.

UNIVERSITY COLLEGE OF
NORTH WALES

Bangor

SCHOOL OF
MATHEMATICS AND
COMPUTER SCIENCE

Applications are invited for the post of Lecturer in Applied Mathematics. Applications from candidates with research interests in any branch of theoretical plasma dynamics or research experience in statistical mechanics will be particularly welcome.

Salary will be on the scale £1,764 (£4,293).

Further particulars of this post can be obtained from the Secretary and Registrar, and applications (two copies) giving details of age, qualifications and experience, together with the names and addresses of three referees should be sent to reach the Secretary and Registrar by 5 March, 1973.

BLUE CIRCLE
GROUP

The Associated Portland Cement Manufacturers Limited, the producing company of the Blue Circle Group, are seeking additional staff at their Southern Area Technical Services Department at Swanscombe, Kent.

The Group manufactures cement and allied products at many locations in the U.K. and overseas.

The Southern Area Technical Services Department aims to provide an expanding development and technical service to works in the southern area in the fields of quality control, process control and chemical engineering.

The following positions are required to be filled in the Quality Control Division:—

Analytical
Chemists

minimum requirements—Ordinary National Certificate in Chemistry; industrial experience preferred;

Technical
Assistants

for work in various sections; minimum educational requirements of 'O' or 'A' levels in scientific subjects and English and preferred desire to continue their education.

The competitive commencing salary will depend upon qualifications and experience and there will be membership of a contributory pension scheme, profit sharing bonus, full welfare and house purchase schemes after serving appropriate qualifying periods.

Applications giving full details of age, training, qualifications and experience should be addressed to:—

**The Quality Control Divisional Head,
Southern Area Technical
Services Dept.,**

**Manor Way,
SWANSCOMBE, Kent.**

THAMES POLYTECHNIC

School of Biological Sciences
Division of Physiology and
Cell Biology

RESEARCH TECHNICIAN

Applications from suitably qualified and experienced persons are invited for the post of research technician to work with Dr D. J. Beadle on the ultrastructural distribution of enzymes in normal and transformed cell lines. The duties of the person appointed will include the culture and maintenance of cell lines and routine electron microscopy. Experience with either of these techniques would be an advantage but is not essential. The post is tenable for 18 months from 1st April, 1973, at a salary of £1469 per annum.

Further information and application form (to be returned by 20 February, 1973) from the Secretary, Thames Polytechnic, Wellington Street, London, SE18 6PF.

AUSTRALIAN NATIONAL UNIVERSITY

Applications are invited for appointment to the following post: **RESEARCH SCHOOL OF PHYSICAL SCIENCES**

Research Fellow/Fellow in Applied Mathematics (1 post) (Mathematical Vision Research).

The main research emphasis is to provide an explanation for the shape, size refractive index and arrangement of the various vertebrate and invertebrate photoreceptor organelles and their effect on vision. Other interests are the mechanism and effects of photo-mechanical movement associated with photoreceptors and surrounding media as well as the transduction process itself. The research would be carried out in conjunction with Dr. W. Snyder, of the Department of Applied Mathematics and in close collaboration with the Department of Neurobiology (Professor G. A. Horridge, FRS) and the Department of Physiology (Professor P. D. Bishop, Dr. W. R. Levick). It is anticipated that the appointee will be a recent Ph.D. graduate, not necessarily in the physical sciences, preferably with an interdisciplinary background and a strong desire to participate in research in vision. The Department, headed by Professor W. N. Martin, has a strong research effort in more general areas involving the applications of mathematics and physics to biology, particularly in colloid science, macromolecule interaction and cell adhesion.

Prospective applicants are encouraged to write to Dr. A. W. Snyder, Department of Applied Mathematics, in the University before making a firm application for the position.

The salary will be in accordance with qualifications and experience within the ranges: Research Fellow \$A\$8,803.52 p.a. (9 x \$504); Fellow \$A\$8,166-\$11,217 p.a. (9 x \$350). Academic salaries are under review.

Appointment as Fellow is for five years in the first instance with the possibility of extension to retiring age. Appointment as Research Fellow is for three years in the first instance with a possible extension to a maximum of five years.

Superannuation is on the FSSU pattern with pensionable contributions. Reasonable travel and removal expenses are paid and assistance with housing is provided for an appointee from outside Canberra.

The University reserves the right not to make an appointment or to make an appointment by invitation at any time.

Closing Date: Further information should be obtained from the Association of Commonwealth Universities (ACPU), 105 Gordon Street, London WC1H 0PF. (Tel: 01-387 8572).

Applications close on 30 March 1973.

THE AGRICULTURAL RESEARCH COUNCIL has a vacancy for an **Entomologist** with entomological experience, in the Unit of Invertebrate Chemistry and Physiology at the University of Sussex. The successful applicant will be expected to take charge of an existing insectary and a new insectary which will be located on the University site. Appointment in the Scientific Officer (£1,206-£2,043 p.a.) or Higher Scientific Officer (£1,346-£2,515 p.a.) grade, depending on qualifications and experience. Superannuation, with allowance to offset contributions. Minimum qualifications: pass degree, HNC or equivalent. At least five years' post-qualifying experience is required for appointment to the higher grade. Preference will be given to candidates with experience of rearing insects for experimental purposes. Applications should be made in writing to: The Secretary, ARC Unit of Invertebrate Chemistry and Physiology, The Chemical Laboratory, The University of Sussex, Falmer, Brighton, Sussex BN1 9QJ.

Entomologist

Forestry Commission, Midlothian

at the Northern Research Station to assist with setting up and assessing field experiments on insect pests; assist in the development of equipment and in the general work of the Station; and undertake some advisory work on entomological problems. Extensive travelling in Scotland and Northern England will be involved and a current driving licence is essential.

Candidates (aged under 27) should have a degree, HNC or equivalent in biology with entomology as a principal subject.

Appointment will be as Scientific Officer (£1206-£2043). Promotion prospects.

Further details from the Forest Research Station, Alice Holt Lodge, Farnham, Surrey or the Northern Research Station, Roslin, Midlothian.

Application Forms from Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, telephone Basingstoke 29222 ext 500 or London 01-839 1992 (24 hour answering service).

Please quote: S645/J6/F
Closing date: 12 March 1973.

Biologist

Ministry of Agriculture,
Fisheries and Food,
Fisheries Laboratory,
Burnham-on-Crouch

to head a small team assessing biological effects of marine pollution, with special emphasis on commercial fisheries. Duties include laboratory studies, ecological investigations on the shore and at sea at various points around the coast of England and Wales and liaison with other Government Departments and the fishing industry. The team is able to call on a full range of laboratory and sea-going services, and there are associated teams investigating chemical and microbiological aspects of marine pollutant problems.

Candidates (normally aged under 32) should have a 1st or 2nd class honours degree in a Biological science with at least 4 years' appropriate post graduate experience.

Appointment will be as Senior Scientific Officer (£2464-£3483).

Application Forms from Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB telephone Basingstoke 29222 ext 500 or London 01-839 1992 (24 hour answering service).

Please quote: S643/A21/F
Closing date: 12 March 1973.

PSYCHOLOGY OR ZOOLOGY GRADUATE required as Research Assistant for 2 1/2 year project on mother-infant interaction using direct observation and interview. To start between March and July. Further particulars from N. G. Burton Jones, Applications to the Secretary (NSR20), Institute of Child Health, 50 Guilford Street, London, WC1N 1EH.

TECHNICIAN OR JUNIOR TECHNICIAN required in the Department of Medicine to assist with research work on Vitamin C and amino acid metabolism according to age and qualifications. Apply in writing to the Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT, quoting Ref. D.M.1.

PORTSMOUTH POLYTECHNIC DEPARTMENT OF CHEMISTRY AND GEOLOGY

Research Assistants in Surface and Solid State Chemistry

The Department of Trade and Industry have placed a contract with this Polytechnic to undertake a research project into factors which affect the triboelectric separation of minerals under the direction of Dr. M. I. Pope. The work will involve (among other techniques) determination of isotherms, measurement of triboelectric charge on mineral surfaces and changes in surface conductivity. This post is available immediately, due to the previous worker having accepted a permanent appointment at a University.

Vacancies will also arise shortly for research assistants to work on (a) the catalytic oxidation of hydrocarbons and (b) the thermal stability and mechanism of decomposition of saturated organic acids.

Applicants for these posts must possess an honours degree, or equivalent qualification, involving Chemistry; triboelectric work, an interest or experience in mineralogy and electronics would be an added recommendation.

The salary of a research assistant will be £120 x £50 to £120 p.a. The proposed research programmes should provide a suitable basis for obtaining a higher degree and every encouragement will be given to the publication of results.

Application forms and further particulars may be obtained from the Staff Officer, Portsmouth Polytechnic, Ravelin House, Alexandra Road, Portsmouth, PO1 2QQ, to whom completed applications should be returned as soon as possible. Please quote Ref. D31.

ROYAL SCOTTISH MUSEUM ZOOLOGIST

... for a post as Assistant Keeper in the Department of Natural History.

Duties will include responsibility for the collection of live invertebrates (other than Mollusca), advising on exhibitions, particularly in the field of marine biology, conducting field-work and, from time to time, lecturing to the general public and societies.

Candidates must have a degree in Zoology with 1st or 2nd class honours, or postgraduate degree, or equivalent qualification, and experience, or proven interest, in marine invertebrates. Experience in the field or at sea in contributing to expeditions would be an advantage.

SALARY: Assistant Keeper, 1st Class (minimum age 28), £2587-£4424; Assistant Keeper, 2nd Class, £1555-£2300. Starting salary may be above the minimum of either scale. Level of appointment according to age, qualifications and experience. Non-contributory pension scheme.

For full details and an application form (to be returned by 9 March, 1973) write to the Royal Scottish Museum, Chambers Street, Edinburgh, EH1 1JF, quoting G14/382.

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL

(University of London)
London, SE1 7EH

RESEARCH ASSISTANT (Graduate or Senior Technician) required in the Department of Clinical Pathology for Biological Research in connection with endocrine and reproductive systems. Experience in animal work essential. Applications with details of qualifications to Professor F. T. G. Prunty.

Smith & Nephew Research Limited

INDUSTRIAL PHARMACOLOGIST

Smith & Nephew Research Ltd., the research and development organisation for Smith & Nephew Associated Companies Ltd. wish to appoint immediately a pharmacologist (male or female) who has graduated within the last three years, preferably with pharmaceutical qualification. Work will be mainly concerned with drug therapies for ophthalmic use, a new and expanding pharmaceutical field. Training will be provided in modern laboratories on a country estate where a wide range of scientific disciplines are practised, in a pleasant working environment.

This is a progressive position for candidates aged not over 26 years in an expanding research company where the rewards and fringe benefits conform to modern practice. In the first instance send brief details of age, qualifications and experience to:



Administration Manager, (P/2)
SMITH & NEPHEW RESEARCH LTD
Gilston Park,
Harlow, Essex.

One of the Smith & Nephew Associated Companies



science editors-

Macdonald Educational

Two experienced science editors are required to join the expanding secondary school textbook department of Macdonald Educational. Initially the work entails the preparation of illustrated textbooks in MATHEMATICS and PHYSICS for students of average ability. Skill in conveying information in simple language and creativity in the use of colour illustrations are essential for both posts. Write briefly in the first instance to Mrs. V. S. Huff, Asst. Personnel Manager, 49/50 Poland Street, London W1A 2LG or telephone 437-1974 for an application form, quoting ref. no. 1080.



Macdonald & Co.
(Publishers) Limited

BUILDING RESEARCH ASSOCIATION OF NEW ZEALAND

The Association has vacancies in its Fire Research Division for CIVIL or STRUCTURAL ENGINEERS or other appropriately qualified staff to work on the following projects:

- research into the effects of fire on the structural behaviour of buildings and building units.
- assistance with the design and commissioning of our laboratory buildings and equipment.
- supervision of testing and assessment of fire ratings on building components and elements.
- evaluation of fire statistics and visits to actual fires: cost benefit studies on building code fire requirements.

Appointees will at first be based in Wellington City, but it is planned that the Fire Research Division will occupy the initial buildings of a laboratory complex for applied research for the New Zealand building industry being developed on a large and pleasant site outside the City.

QUALIFICATIONS: The preference is for Civil Engineering graduates interested in research with some structural experience, perhaps 1 or 2 years, since graduation. Other applicants would however be considered.

COMMENCING SALARY: to be negotiated up to \$6,500.

Sponsored travel and assistance with removal expenses available.

Applications and enquiries for further information should be addressed to The Director, Box 8375, Wellington, New Zealand (Cable address—BRANZ WEL-LINGTON).

JUNIOR TECHNICIAN or newly qualified Technician required for one year in the Departments of Biochemistry and Medicine for research involving gas-liquid chromatography of steroids. Salary up to £1,335 per annum plus £126 per annum London Weighting according to qualifications. Apply in writing, giving details of age, qualifications and experience to the Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT, quoting Ref. B.M.1.

Tropical Products Institute, London

Information scientist

in the Documentation Section to take charge of the Technical Index which provides a unique guide to the literature on tropical agriculture and to the technology and marketing of tropical products. Duties include selection, evaluation and indexing of information and maintenance of an effective retrieval system; assisting with training of overseas personnel and with planning and introducing revised procedures, including computerisation, which may arise from the current review of information handling.

Candidates (preferably aged 35-45) must have knowledge of the latest indexing/abstracting techniques and an awareness of current developments in the agricultural information field. They should normally have a degree, HND, HNC or equivalent qualification in an appropriate subject—e.g. combination of chemistry and biology (especially botany)—but applicants lacking formal qualifications and having particularly relevant experience may be considered. Working knowledge of a foreign language desirable.

STARTING SALARY will be within the scale £2,639-£3,658, non-contributory pension scheme.

For full details and application form (to be returned by 7 March 1973) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB or telephone BASINGSTOKE 29222 ext 500 or LONDON 01-839 1992 (24 hour answering service). Please quote S/8167.

NATURE CONSERVANCY SCIENTIFIC OFFICERS

Salary Range £1206—£2043

The Nature Conservancy has vacancies in the Southern England Region for two Assistant Regional Officers, one based in the Regional Office at Grange-over-Sands, and one based in the Sub-Office at Newcastle upon Tyne.

The officers appointed will contribute to the Nature Conservancy's wildlife conservation and advisory functions by taking part in ecological survey and site assessment, protection of Sites of Special Scientific Interest, Nature Reserve management, provision of advice on conservation matters, the conduct of field trials and monitoring studies, and liaison and administration.

The work requires ability in the preparation of reports and the conduct of correspondence. Experience in public speaking is desirable.

Candidates should possess a degree or equivalent in a biological science and be competent in one or more branches of field biology (preferably including botany). A driving licence is essential.

Starting salary according to qualifications and experience.

Application forms and further particulars are available from Establishments (s), Nature Conservancy, 15 Belgrave Square, London, SW1X 8PY. Please quote reference number P525.

Closing date: 9 March, 1973.
**NATURAL ENVIRONMENT
RESEARCH COUNCIL**

GRADUATE required to join a small team on the Surgical Professional Unit investigating the immunosuppressive effect of tumours, present studies being directed towards human lymphocyte transformation. Biochemical or immunological background preferred. Salary £1,764-£1,862 London Allowance. Applications with two references to The Secretary, The Medical College of St. Bartholomew's Hospital, West Smithfield, London, EC1A 7BE, quoting reference 559.

Overseas Development Administration Education Adviser

£5525 - £6435

to join a team of advisers based in London. His main responsibility will be to advise the ODA on primary and secondary education, teacher training, and the planning, administration and inspection of education. Working closely with the British Council and with other bodies associated with the ODA in the formulation and implementation of HM Government's education aid policies, he will be required to evaluate and report on their effectiveness. Some overseas travel (about 3 months a year) is involved.

Candidates, men and women, and preferably aged at least 45, should normally have a degree with honours (or

an equivalent qualification) in a scientific subject. A good knowledge and experience of education in the UK (and preferably overseas also) is essential.

Starting salary could be above the minimum of the scale quoted. Non-contributory pension scheme.

Fuller details of this appointment may be obtained by writing to the Civil Service Commission, Alencon Link, Basingstoke, Hants., RG21 1JB or by telephoning BASINGSTOKE 29222 ext. 500 or LONDON 01-839 1992 (24-hour answering service) quoting reference G/8152/AQ. Closing date 19 March 1973.

FOREIGN & COMMONWEALTH OFFICE

MERSEY AND WEAVER RIVER AUTHORITY INVITE APPLICATIONS FOR ELECTRONICS TECHNICIAN T. GRADE 5 (£1,803-£2,100)

This is a newly created appointment in the Hydrology Section of the Engineer's Department based at the Headquarters of the Authority, Great Sankey.

Applicants should be suitably qualified and experienced. The person appointed will be responsible to the Assistant Engineer (Electronics) for the assembly and wiring of systems instrumentation used for Water Measurement and Data Logging, preparation of circuit and mechanical drawings and assistance with maintenance, testing and calibration of electro-mechanical apparatus.

Experience in a pre-production laboratory or assembly line workshop where digital integrated circuits and discrete components are used would be an advantage. The work requires an ability to wire, solder and produce simple metalwork to a professional standard.

Application forms and particulars and Conditions of Employment may be obtained by letter or telephone call (extension 140), to J. G. Lloyd, Esq., Engineer of the Authority at the address below. Completed applications forms returnable by 23rd February, 1973.

R. E. Woodward, Clerk and Chief Executive Officer
P.O. Box 12, Liverpool Road, Gt. Sankey, Warrington.
Tel: Penketh 5531.

PLYMOUTH POLYTECHNIC Department of Environmental Sciences

Technician (T3) required immediately for the biochemistry laboratory. Qualifications - H.N.C., H.N.D. or equivalent with considerable experience in a comparable laboratory. Salary: £1,311 - £1,530 plus additions for certain qualifications.

Details and application forms from the Establishment Officer, Plymouth Polytechnic, Plymouth, PL4 8AA, to be returned as soon as possible.

analysts

Applications are invited for two vacancies in our Research and Development Department at Jealott's Hill, which is situated between Maidenhead and Bracknell and is the main centre of ICI's agricultural research activities, primarily concerned with the discovery and evaluation of new chemicals and their application in world agriculture.

One of the vacancies is in the analytical laboratory of the Formulation Section and the successful candidate will assist the Head of the Section to develop quantitative methods for the analysis of pesticides and their formulations based on any analytical methods, other than G.L.C. and L.L.C. which are carried out by another analytical team. A part of this time will probably be spent developing methods based on infra-red spectrometry and developing that technique. (Ref. No. M11).

The other vacancy is in the Metabolism and Residues Section and the successful candidate will join a group of chemists working on the development of methods for the analysis of the trace amounts of pesticides. Experience in the use of modern analytical techniques, in particular gas-liquid chromatography is essential. An enthusiastic interest in instrumental analysis and the ability to work with minimum supervision are necessary. (Ref. No. M12).

Qualifications: HNC Chemistry or equivalent. We would also consider applications from people studying HNC.

We offer good salaries, and working conditions. There is a good self-service canteen and Recreation Club. We operate a Profit Sharing Scheme and Company Pension Fund. Hours 8.45 am to 5.00 pm. Monday to Friday.

If you are interested in applying please write for an application form, quoting the vacancy reference number, to:

Mr. S. R. Stephenson, Personnel Officer.
ICI Plant Protection Limited,
BRACKNELL, Berks.



PLANT PROTECTION
LIMITED

UNIVERSITY OF WESTERN AUSTRALIA Perth

PLANT NUTRITION

Applications are invited for appointment as LECTURER in Plant Nutrition in the Department of Soil Science and Plant Nutrition, Institute of Agriculture, as from 1 July 1973, or as soon as possible thereafter. Candidates should possess a Ph.D. degree or equivalent experience in Plant Physiology, Soil Chemistry or Agricultural Science, and have research interests in plant nutrition. The vacancy has arisen through the appointment of Associate Professor J. F. Loneragan to the Foundation Chair in Biological Science at Murdoch University. He leaves behind a well established and equipped research section oriented towards the physiological behaviour of plant nutrients including trace elements, but the appointee will be free to develop his own research interests. Further details concerning research facilities may be obtained from the Acting Head of the Department, Associate Professor A. M. Posner.

Academic salaries are at present under review. The current salary range for a Lecturer is \$A6801-9330 p.a. Benefits include superannuation similar to FSTU fares to Perth for appointee and dependent family, removal allowance, study leave and long service leave, subsidised temporary accommodation and housing loan scheme.

Applications in duplicate stating full personal particulars, qualifications and experience should reach the Staffing Officer, University of Western Australia, Nedlands, Western Australia, 6009, by 24 March, 1973. Candidates should request three referees to write immediately to the Staffing Officer.

YORKSHIRE FIELD STUDIES LTD.

Assistant Tutor (Male) at the Yorkshire Field Study Centres - North Yorkshire Moors National Park. A Biologist with a good degree, for field teaching post. Wide natural history interest would be added advantage. Salary £750 with full residential emoluments. To commence as soon as possible. Application to Director, Yorkshire Field Studies Ltd., Larpool, Heltham Drive, Whitby, Yorks. YO22 4ND.

Dr. Madaus & Co., Cologne, one of West Germany's leading pharmaceutical firms, seeks suitable

YOUNG GRADUATES

for the extension of its pharmacological laboratories. Applicants should preferably have had a training in physiology, physiological chemistry, pharmacology or zoophysiology. The posts in question are primarily intended for medical, veterinary science and biology graduates. Our work is mainly concentrated on research in the field of the pharmacology of the heart and circulation, inflammation, the gastro-intestinal tract and experimental hepatology. Specialist training in human or veterinary medicine or pharmacology may be taken in our laboratories.

Applicants should have at least a basic knowledge of the German language, although allowances would of course be made for adjustment to conditions. We will be glad to discuss in person any individual problems or queries at our head-offices in Cologne.

Applications should be sent, as soon as possible to:

DR. MADAUS & CO.
Pharmacological Department
5 KÖLN 91
West Germany

COUNTRY KITCHEN FOODS LIMITED

require a recently qualified GRADUATE in Research and Development Department to work on technical problems related to the cultivated mushroom. The job will involve varied and interesting scientific work on an exciting crop grown under controlled environmental conditions, and offers considerable opportunities in a rapidly expanding and progressive company. No previous experience of the crop is required, but a sound, broad-based scientific knowledge combined with good practical ability is essential.

Qualifications: B.Sc. (or Higher Degree) in Microbiology, Agriculture or related subjects.

Applications to: Mr. R. C. Ross, Country Kitchen Foods, Ltd., Harpur Hill, Buxton, Derbyshire.

UNIVERSITY OF NEWCASTLE UPON TYNE Departments of Inorganic and Organic Chemistry RESEARCH ASSOCIATE

Applications are invited for a post-doctoral post as Research Associate to develop the use of the low-temperature matrix-isolation techniques in the photochemistry of organic molecules. Applicants should have previous experience in organic chemistry, in particular solution photochemistry. This appointment will be for two years from 1 October, 1973, in the salary range £1764-£2079, with FSSU.

Applications should be sent to Professor J. J. Turner at the Department of Inorganic Chemistry, University of Newcastle upon Tyne, NE1 7RU, from whom further details can be obtained if required.

Find your place in British Gas

INFORMATION SCIENTIST

British Gas up to £3027

Watson House. To take charge of the Scientific Information Centre, which provides a full information and library service, with emphasis on physical science and engineering subjects. Responsibilities include all day-to-day operations, with future planning and budgetary control. Degree in science or engineering, plus qualifications in Information Science, essential. Alternatively acceptable could be an Information Science qualification with relevant experience. At least two years' experience in similar work required and in post co-ordinate indexing. French/German reading ability an advantage.

Salary £2367-£3027. Application forms from the Director, British Gas, Watson House, Peterborough Road, London SW6 3HN. Closing date for applications 28th February.

BRITISH GAS



UNIVERSITY OF SURREY MICROBIOLOGY TECHNICIAN

Grade 5 (£1881-£2241)

A Technician is required for a responsible post in the Microbiology section of the Department of Biological Sciences. Duties will be equally divided between the preparation of class material up to honour degree level and participation in the research programmes of the Department.

Applicants must be familiar with all basic microbiological techniques and have qualification and experience in either bacteriology, mycology or plant pathology.

Application forms can be obtained from the Staff Officer, University of Surrey, Guildford, Surrey. Tel: Guildford 71281, Ext. 452, and to whom they should be returned by: 28 February, 1973.

THE ROYAL SOCIETY SCIENTIFIC INFORMATION RESEARCH FELLOWSHIPS

Applications are invited for two SCIENTIFIC INFORMATION RESEARCH FELLOWSHIPS for research in scientific information. The appointments are tenable for two years in the first instance from 1 October 1973 and are renewable annually for such periods as the Council of the Royal Society may determine. The stipend will be in the range £3411 to £4047 per annum, with superannuation benefits.

Forms of application are available from the Executive Secretary, The Royal Society, 6 Carlton House Terrace, London SW1Y 6AG and applications are receivable by 30 March 1973.

A SENIOR TECHNICIAN (GAS CHROMATOGRAPHY)

with several years practical experience in Gas Chromatography, is required for our laboratories in Harrogate.

Candidates must also have a minimum qualification of O.N.C. in Chemistry or Applied Biology although H.N.C. would be preferred.

Please write, giving brief information of experience and qualifications to:-

**The Personnel Officer,
Tobacco Research Council Laboratories,
Harlow Hill, Otley Road,
HARROGATE, HG3 1PY,
Yorkshire.**

Scottish Plant Breeding Station

Applications are invited from suitably qualified scientists for the post of

HEAD OF THE FORAGES DEPARTMENT

The post carries responsibility for co-ordinating the department's programme of research which embraces breeding cereals, Brassicas and grasses.

Appointment will be in the Senior Principal Officer grade (salary range £5,350-£6,260 p.a. with F.S.S.U. benefits and 4½% non-pensionable supplementary allowance).

Further particulars and application form may be obtained from the Secretary, Scottish Plant Breeding Station, Pentlandsfield, Roslin, Midlothian, EH25 9RF. Closing date for applications is 28th February, 1973.

University of Dar es Salaam— Tanzania

Applications are invited for the following posts, tenable as soon as possible:

Professor of Crop Production

Candidates should have considerable research and teaching experience in at least one area of Crop Science (preferably Agronomy, Plant Breeding or Crop Physiology). Experience in the tropics is desirable. Appointee will be required to direct research and teaching in the field of Crop Production. He will be expected to participate in the teaching of undergraduate courses and supervise postgraduates in his specialised field.

Senior Lecturer/Lecturer in Crop Science

Applicants should preferably have high academic qualifications and considerable research experience in Crop Physiology or Agronomy. Appointee will be required to teach undergraduate courses in the area of Crop Production (Crop Physiology/Agronomy). He will also be expected to undertake research and supervise postgraduates in his specialised field.

Senior Lecturer/Lecturer in Plant Pathology

Applicants should have a good honours degree in Botany or Agriculture and preferably a postgraduate qualification in Plant Pathology or Mycology together with research and teaching experience in these areas. Appointee will be required to teach Plant Pathology and related aspects of Plant Protection to undergraduate students and, where applicable, supervise postgraduates. He will also be expected to initiate research in the area of Plant Pathology and develop the area in the Department, because such a position has not been in existence before.

Senior Lecturer/Lecturer in Agricultural Botany

Applicants should have a good honours degree in Botany, Agriculture Botany, Agriculture plus a higher degree and/or research experience in Botany or Agricultural Botany. Appointee will be required to teach Agricultural Botany, including Ecology and Agrometeorology to undergraduates. He will also be expected to carry out research in his field of speciality and supervise postgraduates.

Salary scales: Professor T£3,080—T£3,360 p.a. Senior Lecturer T£2,380—T£2,800 p.a. Lecturer T£1,896—T£2,318 p.a. (T£1—£1.19 sterling). The British Government may supplement salaries in excess of £1,400 p.a. (sterling) for married appointees or £300—£150 p.a. (sterling) for single appointees and provide children's education allowances and holiday visit passages. F.S.S.U. Family passages; biennial overseas leave. Detailed applications (2 copies), including a curriculum vitae and naming 3 referees, should be forwarded by airmail, not later than 19 March, 1973 to the Chief Academic Officer, University of Dar es Salaam, P.O. Box 35091, Dar es Salaam, Tanzania. Applicants resident in U.K. should also send 2 copy to Inter-University Council, 90/91 Tottenham Court Road, London, W1P 0DT. Further particulars of these appointments may be obtained from either address.



The Stoke Court Research Department of Miles Laboratories Ltd is engaged in some fundamental pharmaceutical research, and applications are invited for the following appointments:—

CHEMISTRY TECHNICIANS

Two vacancies exist in the Chemistry Department:—

(1) For a Technician to work with a Research Bio-Chemist who is engaged in studying the basic mechanism of anti-inflammatory agents. The work involves enzyme purification & bio-chemical assays.

(2) For a Technician to undertake the synthesis of potential therapeutic compounds. Applicants should possess or be studying for HNC in Bio-Chemistry/Chemistry respectively.

PHARMACOLOGICAL TECHNICIANS

Extension of research in the field of Prostaglandins creates two openings for Female Research Technicians in the Pharmacological Department:—

(1) For a Technician experienced in studying the effects of anti-inflammatory drugs in laboratory animals.

(2) For a Technician who will specialise in isolated tissue preparations and study the effects of Prostaglandins on them. Minimum qualifications for both these positions would be 2 'A' levels, or ONC, and formal training in biological subjects.

Miles Laboratories offer excellent working conditions in modern well equipped laboratories situated in pleasant surroundings. Salaries are attractive. 1973 holiday arrangements will be honoured and interviewing expenses refunded.

Applications in writing please or telephone B. J. Hollinshead, Miles Laboratories Ltd., Stoke Court, Stoke Poges, Slough, Buckinghamshire. Tel. Farnham Common 2151.



UNIVERSITY OF STRATHCLYDE DEPARTMENT OF ELECTRONIC SCIENCE AND TELECOMMUNICATIONS LECTURESHIP

Applications are invited from suitably qualified graduates for a Lectureship in the Department of Electronic Science and Telecommunications.

The appointee will be expected to teach Telecommunications to undergraduate and postgraduate students and some teaching or lecturing experience is desirable. Industrial experience would also be an advantage.

Salary scale £1764—£4299 with F.S.S.U. Picing on scale according to qualifications and experience.

Application forms and further particulars (quoting 3/73) may be obtained from the Registrar, University of Strathclyde, Royal College Building, 254 George Street, Glasgow, G1 1XW with whom applications should be lodged by 28th February, 1973.

IMPERIAL METAL INDUSTRIES (KYNOCHE) LIMITED

Information Assistant

The IMI Control Library, which provides a comprehensive information service to users of the IMI Group throughout the country, will shortly have a vacancy for an information assistant. The duties consist mainly of enquiry work and related literature searches, and abstracting from periodicals for an information bulletin.

Applicants are invited from men or women aged 25—35 years who have had relevant experience in a special library. Possession of a degree in a scientific subject (especially metallurgy or engineering) or a comparable qualification would be an added recommendation.

The post carries a good salary and conditions of employment include membership of Pension and Profit-Sharing Schemes. Please write or telephone, quoting reference no. 264, to:—

Mr. J. Poole, Senior Personnel Officer (Staff)
Imperial Metal Industries (Kynoch) Limited,
Kynoch Works,
Wotton,
Birmingham B6 7BA.
Telephone 356 4848 Ext. 743

a subsidiary company of Imperial Metal Industries Limited



UNIVERSITY OF OXFORD DEPARTMENT OF METALLURGY

Applications are invited for the post of Research Assistant to join a group working in the field of solidification and specifically on a project concerned with macro segregation in castings and ingots. The post is available for two years in the first instance.

Candidates should possess a Ph.D. degree or equivalent. Previous research in solidification or experience in industry would be an advantage. Salary range £1764 (age 24) to £2715 (age 50).

Applications including a brief curriculum vitae should be sent to the Administrator, Department of Metallurgy, University of Oxford, Parks Road, Oxford.

SENIOR PHYSICIST required in Physics Department of Institute of Cancer Research at Royal Marsden Hospital, Sutton to undertake use and development of whole body counters and scanners in clinical investigations with radioisotopes. Relevant experience in apparatus design and development an advantage. Facilities include a well equipped low background laboratory, electronic and mechanical workshops and ready access to digital computers. Salary on M.R.C. scales, starting point dependent on qualifications and experience. Apply in duplicate with names of two referees to: Secretary, 34 Summer Place, London, SW7 5NU. Quote reference LBF 300/G/55.

OXFORD HAEMOPHILIA CENTRE PLASMA FRACTIONATION LABORATORY

SCIENTIFIC OFFICER required to develop and carry out assays of blood coagulation factors, especially in relation to the provision of therapeutic materials for the treatment of blood coagulation disorders. The work requires initiative and exceptional determination. The successful candidate will be expected to participate in other work of the laboratory.

Salary in range £1500-£2040 or £2050-£2110.

Qualifications: 1st or upper 2nd class honours degree, preferably in biochemistry or biological sciences with a good standard in mathematics. Several years relevant experience concerned with biological assays expected for the higher grade.

Appointment would be to the staff of the Institute of Preventive Medicine (F.S.S.U. Superannuation).

For further details and application forms to the Secretary, Plasma Fractionation Laboratory, Oxford Haemophilia Centre, Churchill Hospital, Oxford OX3 7LJ.

UNIVERSITY OF DURHAM ADDISON WHEELER FELLOWSHIP

Applications are invited for one Addison Wheeler Fellowship tenable for three years from 1 October 1973 (or earlier by arrangement) and renewable for a further two years. The Fellowships were established to encourage efforts to increase knowledge of Man and his physical make-up so as to enable him to make better use of himself here on earth. It is assumed that candidates will normally be working in the Life Sciences but candidates working in other fields who feel that their research meets the aims of the Fellowship are encouraged to apply.

Salary on the scale £2121 x £138 to £3565 plus FSSU benefits. No initial appointment will be made at a level higher than £2811. Candidates must be under 28 years of age at the time of taking up the Fellowship.

Applications (3 copies), naming the referees referred to, sent by 28 February 1973, to the Registrar and Secretary, Old Shire Hall, Durham, DL1 3JP, from whom further particulars may be obtained.

THE UNIVERSITY OF WARWICK

Department of Engineering
CONTROL THEORY CENTRE

Applications are invited for a post of Lecturer, tenable from 1st October, 1973, from suitably qualified candidates with interests in control theory.

Initial salary according to qualifications and experience in the Lecturer scale: £1764-£2259 p.a. with F.S.S.U.

Further particulars and application forms may be obtained from the Academic Registrar, University of Warwick, Coventry CV4 1AL, quoting Ref No/2L/73.

Closing date for receipt of applications is 9th March 1973.

ST. BARTHOLOMEW'S HOSPITAL, LONDON, E.C.1.

PHYSICIST for the clinical Radioisotope Department to work on project involving computer analysis of brain-scans. Applicants should be graduates, preferably first or second class honours. Previous experience of brain-scanning techniques not essential. Appointment for one year in the first instance. (Work could lead to Ph.D.) Salary in the range £1278-£1890 plus London weighting according to qualifications and experience. Write, naming two referees and quoting AS/3430, to Personnel Officer.

Dr. Madaus & Co., Cologne, one of West Germany's leading pharmaceutical firms, wishes to extend its pharmacological laboratories and seeks

LABORATORY TECHNICIANS (female or male)

The work involved covers basically pharmacological and/or biochemical analysis of new drugs carried out in animals.

Applicants should have some knowledge of German, although allowances will of course be made for adapting to the German way of life and for gaining more specialized knowledge in the above field.

We consider ourselves a liberal-minded company. Our laboratories are modern and well-equipped. The relationship between staff and executives is open and friendly. The firm lies in pleasant surroundings and we are able to offer first-rate pay and conditions in accordance with West Germany's standard of living. As a result of Great Britain's entry into the Common Market, applicants should have no difficulties in taking up employment in Germany.

Applications should be sent, as soon as possible to:
DR. MADAUS & CO.
Pharmacological Department 5 KÖLN 91
Osterheimer Strasse 198 West Germany

Applicants showing serious interest are welcome to visit our head-offices in Cologne at our own expense and discuss matters in person.

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

The Ridgeway, Mill Hill,
London, NW7 1AA
(Tel: 093-3666)

JUNIOR TECHNICAL OFFICER required in the Division of Physiology and Pharmacology. The main duty will be to assist in a project concerned with the neurophysiological aspects of development. This post would be suitable for a recent graduate. Salary on scale £1428-£2070 p.a. Please apply, with details of age, qualifications and experience, to NS/1001, Collingridge, quoting ref NS/7/FP.

CHELSEA COLLEGE UNIVERSITY OF LONDON

The Department of Physiology has a vacancy for a TECHNICIAN to take responsibility for an electrophysiological research laboratory and to assist in the training of students. Applicants should have a sound knowledge of mammalian physiological techniques, experience with, and an interest in, electronic and recording equipment. In addition, experience in microphotographic techniques would be desirable. Salary Scale: £1726-£2028 per annum plus £175 London Allowance. Application Forms from Mr J. Thornley, Director of Medical Sciences Group, Chelsea College, Manresa Road, London, SW3 6LX.

SENIOR MATERIALS TECHNICIAN

We seek a senior materials and soils technician to run a site laboratory and field testing for pavement construction, asphalt concrete and soils on a contract overseas for construction of a new main runway and taxiways.

Applicants should have experience in senior position in similar circumstances on airport or motorway work and should be capable of training locally engaged staff in laboratory and field testing techniques.

Apply in writing (or telephone 01-350 9700 for an application form) to: Personnel Manager, Sir Appleton Gibb & Partners, Telford House, 14 Tottill Street, Westminster, London, SW1H 9NG.

UNIVERSITY OF EDINBURGH DEPARTMENT OF VETERINARY PATHOLOGY

Applications are invited for the post of LECTURER in VETERINARY MICROBIOLOGY in this Department. Applicants should preferably be veterinary graduates; experience in microbiology would be advantageous, but not essential. In addition to teaching with a view to the successful applicant will be expected to take an active part in the research work in the Department. Research facilities are available in newly built accommodation. Salary scale £1645-£1999 p.a. with placement according to qualifications and experience and with superannuation. Applications, by letter, enclosing the names of two referees, should be sent to the Secretary to the University, Old College, South Bridge, Edinburgh, EH8 9YL, from whom further Particulars may be obtained. The closing date for applications is 17th March, 1973. Please quote reference 1004.

ANALYTICAL INSTRUMENTS LABORATORY

Applications are invited from persons with a university degree or its equivalent to operate the day to day functions of the laboratory, and to assist in the development of 'on-line' analytical techniques. The laboratory is well-equipped with a range of instruments and linked to a real-time computer system. Expertise in mass spectrometric and spectroscopic methods of analysis is required. Background knowledge of instrumentation maintenance and modification would be an advantage. Applicants should state details of experience and naming two referees to: Head of Department of Chemical Engineering and Chemical Technology, Imperial College, London SW7 2BX.

UNIVERSITY COLLEGE LONDON

GRADUATE MICROBIAL
BIOCHEMIST

Applications invited for the post of RESEARCH ASSISTANT in the interdisciplinary ENZYME TECHNOLOGY GROUP concerned with the translation of laboratory techniques of microbial enzyme production, isolation and immobilisation into useful large-scale processes. A broad training in biochemistry and/or microbiology is desirable. Applications to the Secretary, Enzyme Technology Group (NS) Biochemical Engineering Section, Department of Chemical Engineering, Torrington Place, London WC1.

UNIVERSITY OF READING POST-DOCTORAL FELLOWSHIP—STEROIDS

This W.H.O. fellowship is available immediately for studies on the androgens in body fluids, the mammalian testis and the adrenal. Applicants should have knowledge of steroid radio-immunoassay and/or other G.C. or biochemistry experience. Salary in the range £1674-£1825. Appointment for one year initially. Apply to: Mr G. M. H. Wates, Department of Glycobiology & Biochemistry, The University of Reading, Reading RG6 2AH. (Ref: M.06)

INTERNATIONAL FOOD INFORMATION SERVICE

INDEXER

required for preparation of index material for computer-assisted index production. The successful applicant will work at the editorial offices on the campus of The National Institute for Research in Dairying in Shinfield, Reading

Qualifications or experience in food science or related subjects is required, a reading knowledge of one or more foreign languages and experience in information science would be advantageous

Salary in the scale £860-£2,150, starting according to age, qualifications and experience
FSSU benefits, five-day week, floating time, four weeks paid holiday, good promotion prospects

Application forms and full particulars from the Editor
International Food Information Service
Commonwealth Bureau of Dairy Science and Technology, Shinfield, Reading

UNIVERSITY COLLEGE LONDON

CHEMISTRY DEPARTMENT

TECHNICIAN required to assist with research work concerning microwave spectroscopy, structure and properties of small molecules. The work is centred around a Hewlett Packard Spectrometer; previous experience in the field is not required, but a background knowledge of the operation of electronic instrumentation an advantage. Salary in range £1539-£1794+£175 London Weighting or £1801-£2241+£175 London Weighting, depending on qualifications. Initial appointment for two years. Applications to: Personnel Officer (NS), (Technical Staff CE4), University College London, Gower Street, London, WC1E 6BT.

UNIVERSITY OF READING LECTURESHIP IN SOCIOLOGY

Applications are invited for a Lectureship in Sociology. Preference will be given to candidates able to take charge of a course in Social Psychology.

The person appointed should take the duties on October 1, 1973.

Further particulars may be obtained from the Registrar (Room 208, Whiteknights House), The University, Whiteknights, Reading, RG6 2AH, by whom applications will be received not later than March 10, 1973.

The University of Leeds

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for appointment as LECTURER in Mechanical Engineering with special reference to Applied Thermodynamics and Combustion Science. Candidates should possess a good honours degree and have had industrial and/or research experience. They will be required to contribute to both undergraduate and postgraduate teaching programmes, and to take part in the extensive research programme of the Department.

Forms of application and further particulars from the Registrar, The University, Leeds LS2 9JT (please quote 327/1/E). Closing date 19 March 1973.

OK BUREAU specialises in the recruitment of junior and senior technicians for posts in hospitals, medical schools and industry. For further details write or telephone: G.K. Bureau, 17 Shaftesbury Avenue, London, W.1, 01-734 7232. Interviews by appointment.

ST Tubes Division

Research Engineer NDT Centre, Corby

An Engineer is required to join a small group of specialists engaged on NDT research at the Tubes Division Research Centre.

In addition to a good academic background, applicants will preferably have had some experience in Ultrasonics or Electromagnetics as applied to NDT and will be expected to show a lively and constructive interest in the practical detail necessary in steelworks production orientated research.

Computer facilities are available as well as support from allied disciplines.

Corby is a New Town set in pleasant Northamptonshire countryside where prospects for buying or renting accommodation are good.

Please write for an application form (quoting reference TA49) to:-

Manager, Staff Recruitment and Development,
BRITISH STEEL CORPORATION,
Tubes Division,
Corby, Northants.

LONDON BOROUGH OF BARNET

EDUCATION DEPARTMENT

SENIOR LABORATORY TECHNICIAN required at Grahame Park Secondary School, Thirley Road, Burnt Oak, Edgware, Middlesex. Applicants should have several years' experience and preferably have passed the City and Guilds Science Laboratory Certificate (or equivalent) for which an additional salary allowance will be made. Excellent Laboratory facilities. Five day, 38 hour week. Permanent superannuated post. Commencing salary within Technician Grade 3, range £1,416-£1,635 per annum including London weighting.

Application form (s.a.e.) from Chief Education Officer, Town Hall, Friern Barnet, N11 3DL (Ref. GNT/HJ/538).

R. H. WILLIAMS
CHIEF EXECUTIVE & TOWN CLERK

TECHNICAL OFFICER (graduate in Chemistry/Biochemistry) required for research and routine work in radioimmunoassay laboratory in the Endocrine Unit. Salary according to qualifications and experience from £1,635 p.a. Applications to the Secretary, Royal Postgraduate Medical School, Hammersmith Hospital, Du Cane Road, London W12 0HS quoting ref: 2/489/NS.

TECHNICIAN grade 3 required for Geochemical Research. Some field work. Experience in analytical chemistry required. Qualifications OND or two 'A' levels. Salary in range £1539-£1794+£175 L.W. Application forms from Departmental Superintendent, Geology Department, Imperial College London, SW7 2BP.

THE CITY UNIVERSITY London DEPARTMENT OF CHEMISTRY

Applications are invited for a Postdoctoral Research Fellowship for work on the combustion and flammability of hydrocarbon polymers. This Fellowship is being made available as a result of a grant from Hercules Incorporated. It is proposed that the Research Fellow should be appointed for one year in the first instance but the appointment may be renewable for a further year. The starting salary is expected to be about £2,000 p.a.

Further details may be obtained from Professor C. F. Cullis, Department of Chemistry, The City University, St. John Street, London, EC1V 4PB, to whom applications (together with the names of two referees), should be sent before 9th April, 1973.

THE MEDICAL COLLEGE OF ST. BARTHOLOMEW'S HOSPITAL

Senior Technician required for the Academic Department of Obstetrics & Gynaecology which is largely devoted to Research into Cancer in Women, but also undertakes some routine investigations for infertility and pregnancy. Special experience in these fields is not necessary, but basic experience in Laboratory Histology is desirable. Applications should be sent to the Secretary of the Medical College, West Smithfield, London EC1A 7BE, and further details are obtainable from Mr. C. N. Hudson, Tel: 01-606 7777.

LANCING COLLEGE SUSSEX

450 boys: VI Form 200

BIOLOGIST required for September 1973 to teach to 'A' level and Scholarship level. This is the second post in a Department of three. Small laboratory available for research work. Help in extra curricula activities very welcome. Curricula vitae plus names of two referees to the Head Master.

APPOINTMENTS WANTED

NAVAL ARCHITECT, 35, seeks opportunity in development of low-impact technology. Box D596 New Scientist.

BURSARIES

Imperial Cancer Research Fund BURSARIES FOR TRAINING IN RESEARCH

The Council of the Fund will award a limited number of Bursaries at the Laboratories in Lincoln's Inn Fields and Mill Hill for full-time studies leading to Higher Degrees in research fields relevant to cancer. These include Cellular Biology, Virology and Macromolecular Chemistry.

The award will be tenable for three years from October 1st, 1973, with a non-superrannable grant of £1250 a year (subject to tax).

Applications are invited from British subjects, not over 25 years of age, normally resident in the U.K., who hope to have First or Upper Second class degrees in Science in 1973.

Further details and forms are obtainable from The Director of Research, Imperial Cancer Research Fund, Lincoln's Inn Fields, London, W.C.2.

Applications to reach the Secretary of the Fund at the above address not later than 9th March, 1973.

Junior Technician

required in the Medical Physics Department to work mainly in the new High Dependency Nursing Unit at the Children's Hospital. The work will include maintenance and operation of electronic equipment in the Unit and simple analysis procedures. Training facilities will be provided and day release for higher qualification is available. A minimum of 2 'A' levels, or equivalent qualifications or experience is required and the starting salary will be in the range £756-£1,188 depending on age. Application forms and job description can be obtained from the Hospital Secretary, Nottingham Children's Hospital, Chestnut Grove, Nottingham. Applications should be returned as soon as possible.

Nottingham University

FELLOWSHIPS, GRANTS AND SCHOLARSHIPS

AUSTRALIAN NATIONAL UNIVERSITY

Research School of Biological Sciences

RESEARCH SCHOLARSHIP

Applications are invited for a Ph.D. Scholarship in the Research School of Biological Sciences. The successful applicant will be supervised by Professor D. J. Carr and Mr. L. Watson and will investigate the detailed structure and development, and possible metabolic and physiological significance, of certain leaf anatomical features. The work will largely (though not necessarily entirely) be concerned with including aspects of both mesophyll and epidermis.

A Ph.D. Scholarship provides an annual tax-free living allowance of \$4500 with additional allowances for dependants. A Scholarship is tenable for three years, subject to satisfactory progress, and reasonable return fares to Canberra and a grant for some removal expenses are normally paid. Assistance with accommodation is available.

Prospective applicants should write for further particulars to C. G. Plowman, Academic Registrar, P.O. Box 475, Canberra City A.C.T. 2601, with whom applications close on 30 March 1973.

SERVICES

REEVES TELECOMMUNICATIONS LABORATORIES LTD., founded in 1971 by the late A. H. Reeves, the PCM inventor, has capacity available for experimental or theoretical work (feasibility studies, state of art reports, etc.) in many branches of electro optics and electronics. Roystonbury, Royston Road, Harlow, Essex.

PAPER TAPE ACCESSORIES storage systems, spoolers, dispensers, punches, repair parts, editors, mailing boxes, etc. Catalogue from NSA, Data Efficiency Ltd., Haxsted Road, Hemel Hempstead, Herts. HX13T.

STUDENTSHPIS

POLYTECHNIC OF THE SOUTH BANK

Department of Physics
SRC/CAPS RESEARCH STUDENTSHP

Applications are invited from candidates possessing 1st/Upper 2nd Class Honours degree in Physics or equivalent qualifications for an SRC/CAPS studentship leading to the degree of Ph.D. The successful candidate will be required to investigate the nature and extent of the window of silicon semiconductor detectors and the phenomena connected with it. This project is being carried out in conjunction with Nuclear Enterprises Ltd., Sighthill, Edinburgh.

Applications, naming two referees, should be sent as soon as possible to the Head of Department of Physics, Polytechnic of the South Bank, Borough Road, London SE1 0AA. Tel. 01-525 6569 Ext. 2161 from whom further particulars may be obtained.

UNIVERSITY OF EXETER Department of Engineering Science

S.R.C. RESEARCH STUDENTSHPIS

The Science Research Council is prepared this year to offer to suitable candidates a limited number of research studentships tenable in the Department of Engineering Science, University of Exeter. The value of these awards will be £875 per annum basic, plus fees, and supplementary allowances where appropriate.

Current areas of research include: Numerical analysis of laminar and turbulent flows, Fluid transmission lines, Mechanical properties of materials, Prosthetics and clinical research, Research in bioengineering, Computer graphics in educational technology, Vibrations of structures, Identification and adaptive control, Control applications of thyristors and Semiconductor devices.

Applications are invited from eligible science graduates with first or upper second class honours degrees, or students who expect to obtain these standards in 1973, and should be addressed to Professor H. C. Edmunds, Department of Engineering Science, University of Exeter, Exeter EX4 4QF.

FOR SALE

SOUND SYNTHESIS MODULES. DEWBOX cabinets. Cat. 15p. D.E.W. Ltd., 254 Ringwood Road, Fern-down, Dorset.

LECTURES, MEETINGS AND COURSES

CORROSION FOULING AND CRACKING IN

HIGH TEMPERATURE WATER

IMPERIAL COLLEGE

15 & 16 March 1973

Two-day course on water chemistry.

(Department of Chemical Engineering & Chemical Technology)

Cost £16

Further details from:

The Registrar,
Imperial College,
London SW7 2AZ

North East London Polytechnic

The Starling Lectures

Tuesday, 13 March 1973—6.30 p.m.

Controlled Nuclear Fusion in the Energy Scene

R. S. Pease, ScD., Director of the Culham Laboratory

The Starling Lectures are intended to provide up-to-date reviews of various aspects of nuclear science primarily for a non specialist audience. In this, the third lecture in the series, Dr Pease will discuss the prospects and place of nuclear fusion in the future energy scene.

Although attendance at these lectures is free of charge applications for tickets should be made in advance to:—

Dr. W. H. Tait, Ref. BJ141

Department of Physics,
North East London Polytechnic,
Romford Road, London, E15 4LZ.
Tel: 01-555 0811 Ext. 45.

UNIVERSITY OF SOUTHAMPTON

M.Sc. BIOCHEMICAL PHARMACOLOGY

Applications are invited from GRADUATES leaving University or already in industry, with degrees in Biology or Zoology, Biochemistry, Chemistry, Medicine, Pharmacology, Physiology or related subjects for a 12 months course in Biochemical Pharmacology leading to a degree of M.Sc. by examination. The course commences in October 1973. Grants are available for suitably qualified graduates.

The course is specially designed to supplement the previous training of the graduate and to prepare for a career in research and/or industry. It is particularly suitable for BIOLOGISTS who find they wish to move into the more experimental fields after initial graduation or CHEMISTS who wish to move into a more biological field.

For further details write to the Department of Physiology and Biochemistry, The University, Bassett Crescent East, Southampton.

UNIVERSITY COLLEGE LONDON

M.Sc. DEGREE IN NEUROLOGICAL SCIENCE

Applications are invited from graduates who wish to follow a College-based course of study leading to an M.Sc. degree of the University of London. Students attend lectures, practical classes, seminars and tutorials on the anatomy, microscopic structure and physiology of the nervous system, pursue an individual research project under the guidance of a member of staff and prepare a dissertation. The course begins on 1 October 1973 and lasts for one calendar year. M.B.C. postgraduate training awards may be available for successful applicants. Applications to Dr A. R. Lieberman (NS), Department of Anatomy and Embryology, University College London, Gower St, WC1E 6BT.

DOCTORAL PROGRAMME IN TECHNOLOGICAL ECONOMICS

The University of Stirling offers inter-disciplinary research programmes in Technological Economics, leading to the degree of Ph.D. in Industrial, Biological and Environmental fields of study.

Applicants require a good honours degree in science or engineering.

SRC Research Studentships are available.

Enquiries to:

Assistant Secretary (PG)

University of Stirling

Stirling, Scotland

Quoting Ref. PTE/2/1

NATO Advanced Study Institute on

The Scientific Basis of Filtration

at the Churchill College
Cambridge England

July 2-20, 1973

The purpose of the institute is to familiarize Engineers and Scientists from European countries and overseas with the scientific basis of filtration and to integrate the sciences into a framework for the rational analysis, better design and future research in filtration technology.

The Registration Fee of £100 includes residence, meals and lecture notes.

A limited number of stipends covering travelling expenses and registration fees are available to participants from NATO countries.

For further details apply:

Professor K. J. IVES,
Department of Civil and
Mechanical Engineering,
University College, Gower
Street, London, WC1E 6BT.
Telephone 01-387 7050.

ELECTROCHEMISTRY RESEARCH LABORATORY

School of Chemistry

University of Newcastle upon Tyne

RESEARCH IN ELECTROCHEMISTRY

Applications are invited for places on the one year M.Sc. course in Electrochemistry (commencing September) and for Ph.D. studentships in Electrochemistry. The one year course includes lectures covering the kinetics of electrochemical processes, electrochemical synthesis, metal deposition, corrosion and power sources. There is also a research project. The main research areas of the laboratory are in:

Power Sources
Electrochemical Synthesis
Metal Deposition
Corrosion
High Pressure Electrochemistry
and Ph.D. projects will be available in these areas. Candidates should have at the time of admission an Honours degree (minimum II/2) in Chemistry or equivalent qualifications.

For further details and application forms contact: Dr. R. D. Armstrong, Electrochemistry Research Laboratory, School of Chemistry, University of Newcastle-upon-Tyne, Newcastle-upon-Tyne NE1 7RU. Telephone: 0632 28511 Ext. 3050.

THE CITY UNIVERSITY

St. John Street, London,
EC1V 4PB

THE GRESHAM LECTURES

Three one-hour lectures on 'White Dwarfs, Neutron Stars and Black Holes' will be given by Professor R. J. Tayler, Director of Astronomy Centre, University of Sussex, on **TUESDAYS**, February 27th, March 6th and 13th 1973.

Admission Free. Details from the Director of General Studies.

UNIVERSITY OF SURREY Department of Mechanical Engineering M.Sc. Course and Short Courses in THE MECHANICS, MEASUREMENT AND CONTROL OF FLUIDS

Applications are invited for entry to a course starting in October, 1973, leading to a M.Sc. degree. The duration of the course is one year for full-time students and two years for part-time students. Candidates should be honours graduates in engineering or the physical sciences. Holders of recognised equivalent qualifications may also be admitted.

The M.Sc. Course timetable has been arranged as a series of one-topic courses mostly one week long. The arrangement has been devised primarily to make it possible for engineers and scientists in industry and research establishments to attend one or a series of these short courses in topics of specific interest. There are 23 separate courses which fall under the general subject headings of fluid mechanics of internal flows, control theory and systems, flow measurement techniques, mathematics, electronics and transducers.

M.Sc. Course in APPLIED DYNAMICS AND MECHANICAL VIBRATIONS

Applications are invited for entry to the above one-year full-time or two-year part-time course commencing in October, 1973.

The course is intended for graduates in Engineering or the Physical Sciences but graduates of the appropriate Professional Institution with suitable experience will be considered.

A detailed account of the theories of applied dynamics, general vibration, non-linear vibration, energy methods, mathematics, stress analysis, automatic control and instrumentation and electronics with special reference to vibration measurement and recording is presented. Special emphasis is placed on the use of digital and analogue computers for the solution of vibration problems.

In addition, all students undertake an analytical and experimental investigation of a current engineering problem.

The course is supported by an active research group with special interest in the vibration of turbine blades, plates and shells, vibration of marine systems and vehicle dynamics.

M.Sc. Course in BIOMECHANICS

Applications are invited for a one-year course in Biomechanics commencing in October 1973.

The course, which leads to the degree of M.Sc. by examination, is intended for graduates in engineering or the physical sciences on the one hand and graduates in medicine or the biological sciences on the other.

The branch of the course for graduates in engineering and the physical sciences aims to fit them for research and development work in the medical field and so introduce them to the physiological problems which they can help solve.

The branch of the course for graduates in medicine or the biological sciences aims to introduce them to the mathematical and engineering methods and techniques which are applicable to medical and physiological practice and research.

Studies on the clinical aspects of biomechanics are provided by King's College Hospital and by visiting lecturers from other medical establishments. The course is supported by an active research group with special interest in problems related to internal and external prostheses, physical properties of tissues, perfusion techniques, blood flow measurement and low temperature medicine, dental implants and application of fluids to biomedical problems.

The Science Research Council has accepted all the above courses as suitable for the tenure of its Advanced Course Studentships.

Further details and application forms can be obtained from:-

The Department of Mechanical Engineering, University of Surrey, Guildford, Surrey.

HOLIDAYS

SEE NOW-BELIEVE LATER

—In Iceland! You certainly won't be able to believe your eyes the first time you see some of Iceland's unique natural wonders—or believe that any land could be at once so full of beautiful surprises and so unspoilt. There are plenty of sightseeing holidays to choose from. All are little more than 24 hours away from London by air, and they're fully described in our picture-packed Iceland Travel Planner. Send for your free copy now!

Iceland Tourist Information Bureau

Dept F7, 73 Grosvenor Street, London W1X 9DD. Tel: 01-499 9971

SKYLAB MAY 1973

TWO MAJOR SATURN
LAUNCHES WITHIN A
PERIOD OF 48 HOURS

A special 10/11 days excursion to observe these two launches will depart from London for Cape Kennedy on 23rd April 1973. Boeing 707 flights to Florida and luxury beachside accommodation.

£138.00

Brochure from:

Transolar Travel Limited,
6 Church Road, Beeston,
Cheshire.
Phone: 051 445 7444.

PERSONAL

Computer Dating

At last science benefits humanity. Meet the people you love and like through Dateline Britain's best known computer introduction service.

Ring 01-937 0102 or write for details to:

Dateline (NS) III

23 Abingdon Rd., London W8.

Dateline

COMPUTADATE—does what it says quickly and more cheaply than the other Computer Dating Service. Computadate Ltd., 70 Pembroke Road, London, W.8. Telephone 01-437 4874.

THE DATAMATCH computer will quickly and conclusively select your ideal dates. Free details from Datamatch(n) Box 642, Chelsea, London S.W.3. 01-750 3538.

POEMS NEEDED URGENTLY for new books. Exciting prizes. Send poems for free editorial opinion. Regency Press (D1), 45 New Oxford Street, London WC1.

CONFERENCES

AIC

The 2nd Congress of the
'Association Internationale
de la Couleur'
COLOUR 73

will be held at the University of York

on July 2nd-6th, 1973

The programme includes 9 invited survey lectures on various aspects of colour, and over 100 specialist papers dealing with the art, science and technology of colour.

Further particulars and registration forms can be obtained from: Professor W. D. Wright (AIC Colour 73), Applied Optics Section, Imperial College, London SW7 2BZ.

Ariadne

The hidden costs—in human terms—of industrial development are only now beginning to be counted by economists. The motorway that blots out a village, the airport that provides jobs but deprives old people for miles around of their right to doze peacefully are increasingly the subjects of controversy. But where should an overpopulated developing country such as Brazil stop when planning for higher living standards? Its great roadbuilding effort to open up the jungle which represents about half its territory has come under attack from ecologists, fearing new deserts. But there are also the indigenous Indians to consider. Although a government body exists specifically to ensure that the impact of the modern world will not be disastrous, its record is patchy. Two brothers, sometimes working with the bureau, sometimes on their own, have built towering reputations as experts on primitive Indian cultures. In their 30 years among the Indians they have been instrumental in keeping alive whole tribes which might otherwise have vanished from the earth. Now the brothers, Orlando and Claudio Villas Boas are giving up. They see their cause as hopeless. "All the 'pacified' Indians slowly lose their characteristics and authenticity and their culture is corrupted through contact with civilised outsiders". Without rhapsodising over the "noble savage" we might still spare a thought for human beings to whom our version of civilisation is a creeping disease which sooner or later kills them.

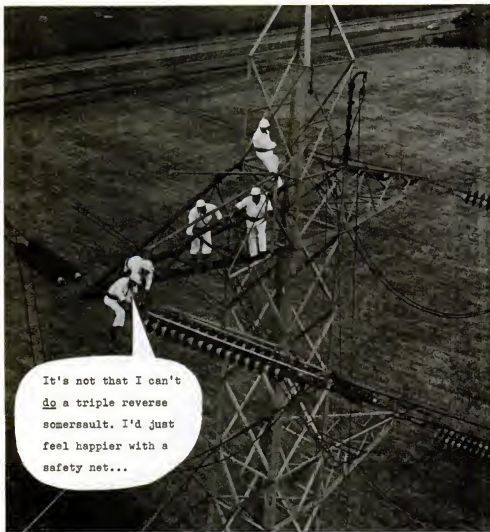
■ Everyone expects exhibits at technical fairs to malfunction occasionally, but one electronics instruments firm became really worried recently. It had a display in which carefully controlled amounts of various materials were fed into plastic boxes. A simple small opening allowed air into the top of the box. The electronics were supposed to keep the levels of the materials constant, but one box, containing Smarties, kept filling erratically. After a great deal of fiddling with various electronic controls the technical hitch was discovered to be a small boy who had cunningly used a pamphlet beside the exhibit to form a tube. By pushing this tube through the hole in the box the inventive lad was able to suck up the goodies while no one was looking.

■ Living as we do in the pscenty of the psychwatchers, where every bit of behaviour has its psychological significance we shouldn't be surprised to find the study extended to eating. In the pages of the journal *Daedalus*, Octavio Paz surveys traditional North American cuisine from a Mexican point of view. He writes of the Yanqui diet with its "tender and fresh colours and flavours—a cuisine equivalent to pastel and watercolour

painting . . . a cuisine with no mysteries: simple, spiceless, nutritious food." His article on "eroticism and gastronomy" will unsettle a few New World stomachs—he writes of the almost apostolic sobriety of lunch, of the suspiciously innocent and pregenital pleasures of ice cream and the milk shake. Against the American glass of milk embodying home and mother and the glass of whiskey or gin marking withdrawal and unsociability (sic), Paz contrasts the subtler beverages of other nations. Even a glass of water is "transubstantiated into an erotic chalice." Times are changing, however: the insurrection of spices against plain American fare parallels the erotic rebellion against Puritanism. It remains to be seen, of course, whether the new gastronomic hedonists can survive a ration of porn and TV dinners.

■ My thermoconservative friend Daedalus once invented a permanent hot bath. It had a countercurrent heat-exchanger in the drain-pipe, so that outgoing waste hot water surrendered its heat to incoming mains water which replenished an insulated tank. Hence an initial thermal "charge" heated the bath for ever. Clearly this neat principle is also ideal for laundries, cookhouses and other prolific rejectors of hot water; but Daedalus is now generalising it still further. Thus a house, for example, loses heat ultimately to the air. If it were

surrounded by a plastic bag with an outlet through a heat-exchanger, so that expired air gave up its heat to incoming air, then all domestic heat would be returned to the building and its fuel bill would be zero! An all-enveloping plastic bag is not perhaps ideal, so Daedalus is devising stand-off decorative cladding—a sort of extra cavity-wall through which air flows to collect heat leaking from the structure. At first Daedalus feared that heat from cooking, electric appliances, and human metabolism would steadily accumulate in the house, unable to escape, until it ultimately caught fire; but he soon realised that small inevitable heat-leaks would prevent this. The system would also work well in reverse in the tropics, when cold air leaving the house would strip heat from incoming air, thus retaining an initial charge of "cold" inside the structure without the need for continuous air-conditioning. On a more personal scale, Daedalus is devising a thermocirculatory suit for arctic explorers, in which all heat leaking through the garment is collected by an air-stream which the wearer then breathes. Again, in principle, the man must ultimately collapse from heat-stroke, so Daedalus will incorporate an adjustable heat-sink in which snow can be melted for tea, etc. But its extension to fashionable winter-wear will probably meet with some consumer thermal resistance.



Scottish secondary schools have a lot to offer desk bound scientists.

That is—graduates and others with similar qualifications and with practical experience in industrial management or research.

They offer more than freedom from your office desk.

They offer a good salary (the basic scale for Honours graduates rises to £2,781) and excellent prospects of promotion to posts commanding salaries of £3,786 and above.

They offer the chance to teach some of the most advanced science courses in the world.

They offer new laboratories and the latest equipment (65% of Scottish secondary pupils are in schools built since the war).

New syllabuses have been introduced in the science subjects so there are very few cobwebs around.

If you would like to learn more about the opportunities in Scottish secondary school education, drop us a line at this address.

We'll send you complete details on salaries, opportunities and how you can qualify.

The Advisory Service on Entry to Teaching in Scotland.

Room G2, 140 Princes Street,
Edinburgh EH2 4BS.

**We'd like you to
come out from
behind your desk.**



THE INFRA-RED REVOLUTION

High performance, low cost.
The Pye Unicam SP1000 Infrared Spectrophotometer. You have got to see it to really appreciate it. In your laboratory or ours. Join the Infra-red Revolution. 'Phone for a demonstration.



PYE UNICAM

Pye Unicam Ltd
York Street Cambridge CB1 2PX
Telephone: (0223) 58866. Telex: 81215



Unicam SP1000 Infrared Spectrophotometer